SHIP PRODUCTION COMMITTEE
FACILITIES AND ENVIRONMENTAL EFFECTS
SURFACE PREPARATION AND COATINGS
DESIGN/PRODUCTION INTEGRATION
HUMAN RESOURCE INNOVATION
MARINE INDUSTRY STANDARDS
WELDING
INDUSTRIAL ENGINEERING
EDUCATION AND TRAINING

February 1999
NSRP 0531

THE NATIONAL SHIPBUILDING RESEARCH PROGRAM

Vendor Furnished Information (VFI); National Marine Standard VFI Guidelines

U.S. DEPARTMENT OF THE NAVY
CARDEROCK DIVISION,
NAVAL SURFACE WARFARE CENTER

in cooperation with
Newport News Shipbuilding

Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE	2. REPORT TYPE	3. DATES COVERED
FEB 1999	**N/A**	**-**

4. TITLE AND SUBTITLE	5a. CONTRACT NUMBER
The National Shipbuiliding Research Program Vendor Furnished Information (VFI); National Marine Standard VFI Guidelines	5b. GRANT NUMBER
	5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)	5d. PROJECT NUMBER
	5e. TASK NUMBER
	5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **Naval Surface Warfare Center CD Code 2230-Design Integration Tower Bldg 192, Room 128 9500 MacArthur Blvd Bethesda, MD 20817-5700**	8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSOR/MONITOR'S ACRONYM(S)
	11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release, distribution unlimited

13. SUPPLEMENTARY NOTES

14. ABSTRACT

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT **unclassified**	b. ABSTRACT **unclassified**	c. THIS PAGE **unclassified**	**SAR**	**191**	

DISCLAIMER

These reports were prepared as an account of government-sponsored work. Neither the United States, nor the United States Navy, nor any person acting on behalf of the United States Navy (A) makes any warranty or representation, expressed or implied, with respect to the accuracy, completeness or usefulness of the information contained in this report/ manual, or that the use of any information, apparatus, method, or process disclosed in this report may not infringe privately owned rights; or (B) assumes any liabilities with respect to the use of or for damages resulting from the use of any information, apparatus, method, or process disclosed in the report. As used in the above, “Persons acting on behalf of the United States Navy” includes any employee, contractor, or subcontractor to the contractor of the United States Navy to the extent that such employee, contractor, or subcontractor to the contractor prepares, handles, or distributes, or provides access to any information pursuant to his employment or contract or subcontract to the contractor with the United States Navy. ANY POSSIBLE IMPLIED WARRANTIES OF MERCHANTABILITY AND/OR FITNESS FOR PURPOSE ARE SPECIFICALLY DISCLAIMED.

Vendor Furnished Information (VFI)
National Marine Standard VFI Guidelines
Final Report

Contract Number N00014-94-2-0011
Avondale Purchase Order Number MB00888

NSRP Project No. 6-96-2

NSRP Panel SP-6

Submitted by:
Avondale Industries, Inc.
P.O. Box 50280, Mail Stop 98
New Orleans, LA 780150-0280

February 28, 1999

Table of Contents

APPENDICES

1 INTRODUCTION

1.1 Background

In February 1997 the National Shipbuilding Research Program (NSRP) Panel SP-6 tasked Avondale Industries Inc. (AAI) to develop guidelines for the timely and accurate transfer of information between vendors and shipyards during the ship acquisition process. M. Rosenblatt & Son, (MR&S) along with First Marine, were subcontractors to AII in this project. The goal of this work is to reduce the time for the design, acquisition, construction, and repair process in the U.S. shipbuilding industry.

One of the factors behind the competitive advantage shared by most international shipbuilders over those in the U.S. is the length of time of the shipbuilding cycle from inquiry and/or order to delivery of the ship. The practice followed by most U.S. shipbuilders is to develop a "new" design for each inquiry. This often results in designing the ship twice. Shipyards typically develop the preliminary and contract designs by using general descriptive data for equipment specified in the contract documents. This descriptive data is insufficient to properly support development of post-contract documents. During the detail design phase, additional information on vendor furnished items is necessary and the design must be modified to account for the detailed information provided. These modifications can amount to a total redesign of the vessel.

World class international shipbuilders use a different process. Most foreign shipyards have developed a "standard" design for a particular type of ship based on their own market analysis. These "standard" designs incorporate international marine components and process standards. They also use standard marine equipment that contains readily available detailed vendor information. If owners require custom items, then the shipyards can tailor the information to areas of the ship that may require changes. Even if a totally new design is required, vendor information is available at the earliest stage of ship design. International shipbuilders avoid late changes in the design development cycle due, in large part, to their database of accurate and current vendor information.

1.2 Objective

The objective of the Vendor Furnished Information Guidelines project is to develop tools for U.S. shipbuilders that will lead to shorten the time required to design a vessel and improving their competitive position internationally. The tool that has the most applicability, in spite of the diversity that exists among U.S. shipbuilders, is the generic model of the ship building process. Every shipyard will benefit from a study of the generic model. Shipyards will be able to adopt all or part of the format and implementation strategies presented in the Vendor Furnished Information Guidelines. The education of vendors and shipyards will ultimately improve the chance that the objective will be achieved.

1.3 Technical Approach

The first phase of this project developed models of the U.S. design/construction process and the international design/construction process. It also included an analysis of the differences between the two models and the formation of a new strategy for U.S. shipyards. This work was documented in Appendix A, which described the results of an analysis of domestic and international design processes. These results are presented in Chapter 2 of this report.

Based on the results of the analysis described in Chapter 2, a "strawman" was developed. This "strawman" included the development of a Master Equipment List (MEL) for Propulsion Data (Appendix B) and a Vendor Information Requirements List, VIRL, (Appendix C). These documents were tested by circulating them among shipyards and vendors. The results of this survey were documented in Appendix D. These results are summarized in Chapter 3 of this report.

The results of the industry survey indicated the importance of the shipyard/vendor relationship in world-class shipyards. Therefore, a second survey was conducted with Italian shipbuilders and their vendors in order to further investigate this relationship. The results of this survey were documented in Appendix E and are summarized in Chapter 4 of this report.

The cumulative results of all of all phases of this VFI project are summarized in the conclusions given in Chapter 5.

Finally, materials were developed to assist shipyards in the development of their own VFI implementation plans. These materials are presented in Chapter 6. They include Appendix F, which contains a shipyard implementation plan, and Appendix G, which includes materials and implications for the vendor.

2 COMPARISON OF U.S. AND EUROPEAN SHIPYARDS RELATIONSHIPS WITH VENDORS

The U.S. and European shipyard relationships with vendors were analyzed in Appendix A. From this analysis it was found that the relationships between U.S. and European shipyards and vendors differ considerably. It appears that the basis for the difference in Vendor Furnished Information is found in the fundamental difference in business relationships and the development and maintenance of shipyard standards. The highlights of the characteristics of the U.S. and European practices are summarized in the following sections.

2.1 U. S. Practices

1. The shipyards have significant experience in working with DoD and other government projects and little recent experience in dealing with commercial ship owners. Therefore, most shipyard business practices were developed to meet the requirements of DoD and government ship building programs.
2. Short-term (purchase order to purchase order) relationships between shipyard and vendors are typical.
3. Shipyards sometimes find it difficult to get information from vendors before the purchase order is issued.
4. Shipyards put an emphasis on low first purchase cost. Also cost is addressed at the item level rather than the system level. Experience, however, has shown that the low cost vendor's equipment may be more expensive for the shipyard to implement into the design and that the low cost vendor may also experience difficulties meeting schedule commitments.
5. There is a tendency to encourage competition between a large number of vendors to ensure lowest cost. This practice limits a vendor's chances for sales and reduces vendor interest.
6. Communication with the vendor is conducted via telephone, FAX, catalogs, WWW browsers, and 2D CAD drawings.
7. The use of computer technology is limited at present but quickly emerging. Many current shipyard business practices are paper document based. 2D and 3D CAD systems are used for Engineering and Production Engineering. The present configuration is quickly changing to a computer-based system for both engineering data and business data. The exact format and content of the new systems, including supporting data such as Vendor Furnished Information, are still under development.
8. Some current and past problems with vendor data can probably be related to unique U.S. DoD requirements. These include technical data associated with hardware and business rules. When the DoD requirements are greater than the typical commercial practices, the vendor must develop data to meet the DoD requirements, forgo the

business, or make a bid and sometimes eventually fail to deliver the required data. This leaves the shipyard to make up the deficiency itself.

9. U.S. shipyards' access to foreign vendors is somewhat limited due to the lack of reliable information on these vendors, their products, and a stable, beneficial, working relationship. This access is further hampered by "buy American" clauses in government contracts.

2.2 European Commercial Shipyard Practices

1. The shipyard will have a list of "preferred vendors" around which the contract price and delivery schedule of the vessel has been based. Should the owner wish to deviate from these preferred vendors, there can be cost and schedule implications.
2. The shipyard will vigorously endeavor to protect the "preferred vendors list" since it has built a relationship with these vendors in terms of special discounts and populated a database of information on their products. The shipyard makes extensive use of a preferred vendor database during the bidding and contract phases of a project.
3. Using consistent vendors and systems allows the shipyard to use design data from previous vessels to the maximum extent possible. The design data is contained within the shipyard's standards. Through the use of these standards, the same or similar components can be identified for incorporation into the engineering drawings for new designs. This allows for early requisitioning and order placement.
4. Standards include a library of blue prints that describe the functions of the systems, the inherent machines and equipment, the performance, the configuration, and the route. They may be accompanied by parts and materials lists along with the vendor's data and name. The shipyard standards are the cornerstones of the vessel. They contain the outfitting information for the vessel and help to determine which vendors are selected.
5. The list of major equipment in the standards can be ninety-percent generic with the vessel type deciding the remainder. This indicates a very high degree of commonality across ship types.
6. A relationship must exist between the shipyard and its supply chain to allow the standards database to be constantly in the forefront of new developments. This permits the shipyard to have a set of building blocks that can be quickly assembled it also provides the guidelines for the vendor to adopt products to shipyard production process.
7. The formation and use of the standards database is greatly simplified by the use of computer technology including 3D product models that contain information on component parts.
8. A Fire Protection and Safety Plan will include the identification of vendors. The preferred vendors list will identify those vendors that are offering solutions that are "type approved" by the applicable regulatory authorities and those which receive

approval as a matter of course. Tried and proven solutions take precedence over innovative solutions.

9. The shipyards possess “families” of standard pipe banks, machinery modules, equipment modules, transit racks, workshops, and control stations. These are used with as few changes as possible.

3 ANALYSIS OF SHIPYARD AND VENDOR RESPONSES TO VIRL/MEL QUESTIONNAIRE

3.1 Introduction

Copies of the Propulsion Equipment MEL and the VIRL specification were sent to several U.S. shipyards, domestic equipment vendors, and foreign equipment vendors. These companies were asked to assess these documents by responding to a list of questions.

- **Master Equipment List**. To accomplish this end, a Master Equipment List (MEL) for Propulsion Equipment Strawman was developed (Appendix B). This document included all of the propulsion machinery and the electrical service equipment for a typical 15,000 DWT tank ship. This list was organized using the U. S. Navy Ship Work Breakdown (SWBS) system.

- **Vendor Information Requirements List**. In addition to the MEL, a Vendor Information Requirements List (VIRL) was developed (Appendix C). The VIRL was a template for specifying the delivery of vendor information. It was developed from the shipyard perspective and describes information that the shipyard requires during a typical ship design and construction process.

Responses were received from three shipyards, four marine engine vendors, and five general marine vendors. These responses have been compiled and analyzed in Appendix D. The results and conclusions of this questionnaire are summarized below.

3.2 Analysis and Discussion of Results

This section includes an analysis and discussion of the shipyard and vendor survey results.

3.2.1 MEL

The shipyard and vendor comments on the MEL showed many similarities and a few differences. The responses have been compiled into the following consolidated list:

1. Shipyards and vendors agree that the MEL is generally too extensive for a single vendor although most would be willing to provide the majority of this equipment.
2. There was some variation in response based on size and power of the propulsion system with smaller systems being more likely to be filled with a few large orders or even a single order.

3. The response also varied depending on the engine vendors' scope of supply. Some engine vendors were willing to provide entire supply by subcontracting out equipment that they did not manufacture.
4. Major engine vendors could provide most of list including: the main engines and auxiliary support systems, CPP propeller and auxiliary support systems, propulsion reduction gear, clutches, couplings, shafting, bearings, bridge and engine room controls and sensors, most pumps, tools, supervision and advisory work, generator sets, PTO generator sets, and generator auxiliary support systems.
5. Major engine vendors usually would not supply the integrated controls software, uptake piping, bow thruster, steering gear, and transfer pumps. Some areas would not make sense for the engine supplier such as where interferences within the ship would be complex or cost prohibitive for the engine supplier. If there is a potential for change or an installation becomes ship specific then the shipyard should assume the responsibility.
6. Even when the engine vendor provides a single source of supply with a single purchase order separate specifications are usually developed. These specifications are developed jointly. The shipyard provides a performance specification. The supplier then develops a detailed specification. The vendor and the shipyard then jointly develop the final specification and design. This process requires a high degree of trust and a close working relationship.
7. The bundling and assembly of engine room items into modules would help the yard assembly process. This requires a close vendor/shipyard relationship with a large amount of shared information and experience.

3.2.2 VIRL

The comments on the VIRL differed between shipyards and vendors. Shipyards generally felt that this was a useful document with adequate detail. The vendors were not as comfortable with the level of detail and often expressed the sentiment that the VIRL tended to over-prescribe with little benefit to the shipyard and added cost to the vendor. Specific comments include:

1. VIRL is generally a helpful document for yards to prepare contract specifications. It is expected that the VIRL would be a project-specific document.
2. The format of the VIRL is reasonable with most items being necessary.
3. Engine vendors tended to feel that some items in the VIRL were too specific or formal. They suggested simplifying the VIRL to only include required items. One shipyard noted that the VIRL contained a significant amount of data not needed by the shipyard or owner.
4. Relying on industry standards (class, ISO, etc.) would be less costly.
5. One vendor noted that the VIRL has many requirements forcing the vendor to prove design, prove methods of design, and prove methods of manufacture. He felt this shifted responsibility wholly to the shipyard and was contrary to "best commercial practice" where the supplier accepts responsibility. In this instance the shipyard and owner will trust the vendor to know and apply the best method.

6. Specifics about dates will vary. Contract dates are often developed without knowing the actual shipyard "need" dates. Designers should be given greater latitude to decide when and what they need. This involves pushing the decision down to the working level. Dates should not be set too early in the process.
7. Vendors noted that all requests for data or to reformat data are costly. Recommendations were made to state "vendor format acceptable" whenever possible.
8. Consider cost and schedule impact of vendor response to VIRL.
9. Limitations on vendor manpower resources can cause schedule slips when responding to custom data requests.
10. Allow vendor to answer requests by using standard equipment documentation.
11. One shipyard requested adding a Milestone Payment Request column to indicate if an item is linked to a payment.

3.2.3 Shipyard/Vendor Relationship

Perhaps the most significant portion of this survey is the shipyard/vendor relationship. Both vendors and shipyards expressed interest in establishing a preferred vendor relationship. Many shipyards and vendors had already entered into some form of this relationship with vendors entered on a yard Maker's List.

1. Pre-award identification of preferred vendors who are identified as teaming members with shipyard.
2. Sequence of documentation should include a Functional Specification, Detailed Specification, and Final Manufacturing Specification.
3. Relationship (trust and teaming agreement) is more important than data formats.
4. Shipyards and vendors agreed on the value of pre-qualification of vendors and availability of data during the bidding and design process. There should be a mutual relationship with shared responsibilities.
5. Dates should be set as late in the process as can be reasonably done.
6. The simple existence of an Integrated Process Team does not assure a working relationship based on trust.
7. Vendors and shipyards agreed that price competitiveness alone is one of the least important aspects.
8. Vendor shipyard relationships must be developed at high levels in both organizations with an eye toward the long term or they will fall apart. This allows both parties to be ambitious and successful in the sale of the ship, as well as the equipment. Both vendor and shipyard need to think like owners, who are their eventual customers.
9. Ability of vendor to assist shipyard in leveraging cost, customer service, and cycle time are very important. Also important is the ability to collaborate in design and minimize various types of cost exposure and technical risk. These are significant market differentiators.

3.2.4 Other Comments

The following is a compilation of other comments received during the survey.

1. One shipyard noted that the problem is not the lack of data, but the lack of understanding of the details required by the shipyard (both inside and outside) and the vendor.
2. What processes do world-class shipyards use?

4 SURVEY OF EUROPEAN SHIPYARDS AND VENDORS

4.1 Background

Perhaps the most significant portion of the VIRL/MEL questionnaire described in Chapter 3 was the discussion of the shipyard/vendor relationship by the participants. Both vendors and shipyards expressed interest in establishing preferred vendor relationships. Many shipyards and vendors had already entered into some form of this relationship with vendors entered on a yard maker's list.

Recognizing that shipyard/vendor relationships in Europe differ significantly from U.S. shipyard/vendor relationships, the project team organized and executed a survey of Italian ship builders and several major equipment manufacturers. The survey responses noted many aspects of this relationship including:

- The pre-award identification of preferred vendors who were considered teaming members with the shipyard.
- It was also noted that the relationship (trust and teaming agreements) was more important than data formats.
- Shipyards and vendors agreed on the value of pre-qualification of vendors and the availability of data during the bidding and design process. This should be a mutual relationship with shared responsibilities.
- Vendors and shipyards agreed that price competitiveness alone is one of the least important aspects of the relationship.
- Vendor-shipyard relationships must be developed at the working technical level and at the senior management level in both organizations with an eye toward the long term or the relationships will not succeed. These relationships should allow both parties to be ambitious and successful in the sale of the ship as well as equipment sales. Both vendors and shipyards need to think like owners, who are their mutual customers.
- Ability of the vendor to assist the shipyard in leveraging cost, customer service, and cycle times are very important. Also important is the ability to collaborate in design and to minimize cost exposure and technical risk.

The survey was conducted by holding a number of interviews from 27 October through 30 October, 1998. These interviews were arranged with the assistance of International Marketing & Business, Inc. located in Washington, D.C. A detailed report of the survey and the results are given in Appendix E and are summarized in the remainder of this chapter. The surveyed companies are shown in the following table.

Italian Shipyards and Vendors Surveyed

Date	Location	Subject of Interview
27 October	Trieste, Italy	Fincantieri – Cantieri Navali Italiani SpA (World class ship builder. Specialties include cruise ships, large monohull ferries, Ro-Ro vessels, and LNG ships.)
		Wartsila NSD, Grandi Motori Trieste SpA, (Diesel engine manufacturer.)
28 October	Monfalcone, Italy	Navalimpianti Group SpA (Vendor for cargo doors, ladders, liquid cargo handling systems, and boat davits.)
	Venice, Italy	MANA Costruzioni e Manutenzioni Navali, Srl (Small shipyard and subcontractor for Hopeman Brothers. This organization is also a subcontractor building outfitting systems for the public spaces on the Disney cruise ships.)
29 October	Vicenza, Italy	SADI SpA (Marine manufacturer cabin interiors and public spaces including false ceilings and sign systems.)
	Verona, Italy	Marine Equipment Pellegrini, Srl (Manufacturer of deck machinery, davits, cranes, hoists, and anchor handling gear.)
	Verona, Italy	Officina Forcato (Manufacturer of marine interior lights and navigation lights.)
30 October	Acqui Terme, Italy	Pompe Garbarino, SpA (Manufacturer of all types of marine pumps.)

4.2 Summary Of Results

During the interviews it was found that there was a surprising degree of consensus within the organizations and individuals that were included in this study. A number of significant points were raised repeatedly. They are summarized below:

1. The influence of vendors and impact of vendor costs are enormous factors in modern shipbuilding. Vendor costs account for 60% to 75% of total shipbuilding costs for large cruise ships. The success of large and complex ship building programs relies upon a strong network of skilled vendors.
2. European shipbuilders have developed a network of preferred vendors with whom a formal business relationship is established. Preferred vendors are not guaranteed business, but are shown a preference. The relationship between shipyard and vendor is different depending on the scope of supply. Major vendors represent the largest amount of business, are critical to the success of the program, and impact major milestones in the production schedule. These include propulsion systems,

entertainment systems, steel, public areas, galleys, accommodations, fire fighting systems, cargo systems, and bridge and navigation systems. The shipyard develops and maintains a complex and diversified network of vendors and material suppliers who have a strategic impact on shipbuilding programs. These vendors have global marketing perspectives and are continuously monitoring and applying innovations in technology. They propose new opportunities from the market and create confidence in the sources of supply.

3. There has been a significant increase in turnkey contractors in the last 10 years. These turnkey contractors provide all aspects of some portion of the ship or ship systems. The turnkey vendor-shipyard relationship is difficult to develop and maintain, but the rewards are significant. Turnkey vendors must be highly skilled and there is a risk that using them can increase costs if the process is not carefully managed. However the careful use of turnkey vendors reduces shipyard construction costs and shortens delivery schedules.
4. Each shipyard is faced with a unique situation considering a number of diverse factors including specialization, local business practices and regulations, physical restraints including storage capacity, shipping, crane capacity, size of the organization, access to vendors, and other factors. This unique combination of factors dictates an equally unique business strategy and vendor relationship. There are no stock answers. Likewise, owners also have individual preferences based on their business goals. The vendor must anticipate all of these preferences.
5. Some shipyards are meeting the challenge of optimizing purchasing through the development of pooling organizations, such as the EuroShip group. This organization is comprised of four shipyards: Fincantieri (Italy), Howaldtswerke Deutsche Werf (Germany), Chantiers de l'Atlantique (France), and Astilleros Espanoles S.A.(Spain). EuroShip provides a forum for member shipyards to exchange data. They have developed standards for common vendor items and have also developed purchasing agreements with vendors. Through one to two year agreements, high volume suppliers and standardized material vendors agree to provide their standard items at a guaranteed cost. The vendor benefits from increased volume and the shipyards benefit by a lower cost. This organization also provides a forum for sharing knowledge of the vendor market.
6. The technical personnel from shipyards and vendors must have a strong relationship. For instance, the supplier often gives suggestions in order to make a system less expensive or more functional. The shipyard designers often ask the suppliers to help solve problems before the supplier is involved in the project.
7. Lead-time is a major factor as ship delivery schedules are compressed. This is especially important with all long lead-time items. The goal is to get the vendor involved as early as possible in a manner consistent with the lowest cost, acceptable quality, and schedule requirements of the shipyard. The present system is still struggling with this issue as the shipyard purchasing process sometimes loses valuable time during the bid process. This is a major area of study for both vendor and shipyards.
8. Larger shipyards tend to be more bureaucratic, smaller yards have simpler structure with the same person having both technical and purchasing authority. The bureaucratic delays and inherent isolation of the larger shipyards result in a longer

time for inquiry. Therefore there is a shorter time for the vendor to respond once the order is made. Vendors are often forced to begin a project prior to receipt of a formal order.

9. Both vendors and shipyards desire to develop a partnering relationship that will allow greater integration of the vendor products into the design. This would result in the vendor being more involved in the project in the pre-award phase thereby reducing communication lags. This growing trend has not reached maturity and the exact method of implementation remains uncle

5 CONCLUSIONS

The European shipbuilding industry is strong and diverse. It has been successful in the world market when producing high value ships such as cruise ships, Ro-Ro ships, LNG carriers, parcel tankers, chemical tankers, and high speed ferries. This success has continued during a time when the shipyard workforce has shrunk as the majority of the costs have been shifted to vendor supply. This transition has required developing and maintaining long term relationships between vendors and shipyards that transcend the traditional purchase order driven environment.

The vendor labor hours accounts for a major portion of the labor hours required for ship construction. In a large cruise ship approximately 50% of the laborers working onboard the ship during outfitting are subcontractors. This very large percentage of vendor laborers requires the vendor to be very knowledgeable of and skilled in the application of shipyard procedures.

The use of information technology and CAD/CAM/CIM systems are essential for delivering complex ships in the global market. However, the effectiveness of this high technology is limited unless the shipyard-vendor relationship is highly developed and carefully maintained. Vendor relationships differ for small shipyards versus large shipyards. The larger shipyards are more bureaucratic, communication more difficult, and there are longer delays. Smaller shipyards can respond more quickly. Vendor relationships with shipyards are largely molded by the vendor scope of supply. Vendors that supply material and stock components do not require the close integration that is necessary for vendors that supply complex systems and subsystems.

There are no pat answers, the situation varies from locale to locale and is continuing to change over time. The general trend is for vendors to provide more services on a turnkey basis. Vendors are continuing to expand their scope of supply to include more engineering and design services in addition to their basic hardware offerings. Shipyards are looking more to vendors to supply these services and bring their expertise and knowledge of new technological developments during the pre-contract phase of a project. Engine manufacturers are offering turnkey services for total design, build, and installation of all equipment in machinery spaces. The outfitting contractors are offering similar services for complete design, building, and installation of all outfitting in areas of the ship. These major subcontractors will utilize the services of a large number of third-tier subcontractors.

Vendors and shipyards are beginning to think more in terms of lifecycle support and of the ultimate customer, the ship owner. Finally vendors and shipyards are exploring ways to develop partnerships that would result in even closer links between their organizations.

6 IMPLEMENTATION PLAN AND TRAINING MATERIALS

The VFI project deliverables 2, 3 and 4a have been combined into two Microsoft PowerPoint presentations which are designed to plan and support the implementation of the outputs of the VFI project. One presentation is designed for shipyards, the other for vendors.

The presentations are animated for use with a projector connected directly to a computer. However, if this facility is not available they can be printed onto Viewgraphs or used as paper handouts. Both presentations contain the basic format and include all pertinent information. It is intended that they will be customized by individual shipyards prior to use.

Both presentations have a similar content. They explain why the project was undertaken and describe how it was undertaken and what its conclusions were. They also explain the VFI system that has been developed by the project. The shipyard specific presentation, Appendix F, also contains an implementation plan. It is intended that this presentation be used by a VFI project team to develop their own plans and subsequently to train other members of the shipyard in the use of the VFI system. It is anticipated that the presentation to vendors, Appendix G, will require a greater degree of customization. The shipyard's own corporate image and intended relationship with vendors also needs to be reflected in the presentation.

Appendix A

Report on Results of Analysis of Domestic and International Design Process, Vendor Furnished Information (VFI) Development Guidelines, 10/27/97.

Report on Results of Analysis of Domestic and International Design Processes

10/27/97

Vendor Furnished Information (VFI) Development Guidelines

NSRP Project No. 6-96-2
NSRP Panel SP-6

Prepared by:
Avondale Industries, Inc.
with M. Rosenblatt & Son, Inc. and
First Marine International, Ltd.

Table of Contents

1. Introduction

1.1. Overview

One of the factors behind the competitive advantage shared by most international shipbuilders over those in the U.S. is the length of time of the shipbuilding cycle from inquiry and/or order to delivery of the ship. The practice followed by most U.S. shipbuilders is to develop a "new" design for each inquiry. This often results in designing the ship twice. Shipyards typically develop the preliminary and contract designs by using general descriptive data for equipment specified in the contract documents. This descriptive data is insufficient to properly support development of post-contract documents. During the detail design phase, additional information on vendor furnished items is necessary and the design must be modified to account for the detailed information provided. These modifications can amount to a total redesign of the vessel.

World class international shipbuilders use a different process. Most foreign shipyards have developed a "standard" design for a particular type of ship based on their own market analysis. These "standard" designs incorporate international marine component and process standards and use standard marine equipment that contains readily available detailed vendor information. If custom items are required by owners, then the shipyards can tailor the information to areas of the ship that may require changes. Even if a totally new design is required, vendor information is available at the earliest stage of ship design. International shipbuilders avoid late changes in the design development cycle due, in large part, to their database of accurate and current vendor information.

1.2. Objective

The objective of the Vendor Furnished Information Guidelines project is to develop tools for U.S. shipbuilders that will lead to shortening the time required to design a vessel and to improving their competitive position internationally. The tool that has the most applicability, in spite of the diversity that exists among U.S. shipbuilders, is the generic model of the ship building process. Every shipyard will benefit from a study of the generic model. Shipyards will be able to adopt all or part of the format and implementation strategies presented in the Vendor Furnished Information Guidelines. The education of vendors and shipyards will ultimately improve the chance that the objective will be achieved.

1.3. Technical Approach

The technical approach for this project is divided into three phases.

1. Develop The Strategy. The first phase develops models of the U.S. design/construction process and the international design/construction process. It also includes an analysis of the differences between the two models and the formation of a new strategy for U.S. shipyards.
2. Test The Strategy. Develop a "straw man" of the new strategy and test it by circulating it among shipyards and vendors.
3. Implementation. Develop an education and communication plan for vendors and shipyards and identify areas for future shipyard/vendor interface.

This report is an analysis of the U.S. and International design construction process in Phase 1. The researchers are now concentrating their efforts on developing a new strategy for U.S. shipyards and are beginning Phase 2 to Test the Strategy.

2. Typical U.S. Design Process

The following discussion is a description of the generic U.S. design/construction process shown in Figure 1.

2.1. Pre-Contract Cycle

A. Owner Identifies Requirements. The Vessel Owner investigates a market for transporting a given commodity between two points and identifies a need for a ship. Often the Owner also identifies a second commodity that requires return transportation. This helps to make the project viable. The Owner develops a set of constraints and a performance envelope for the ship based upon his understanding of the market and the overall economic picture.

B. Concept Design/ROM Cost Estimate. The Owner's technical staff or Design Agent prepares a concept study that outlines the vessel's capacity, speed, manning, ROM operating costs, etc. Little, if any, Vendor Furnished Information (VFI) is required at this juncture unless some very unique feature is anticipated. The Owner evaluates the concept study and market data to determine the potential economic return for the project. This may result in the abandonment of project, a return to step A, or the decision to proceed.

C. Bid Package Preparation. If the decision is to proceed, the Owner asks his technical staff or Design Agent to prepare a bid package with drawings and performance specifications that include regulatory body and classification society compliance. The package may also include a preferred vendor list. A parent design may be used as a starting point. Some VFI is required for unique items (specification type information which requires direct liaison between the Design Agent and the Vendor) and for major equipment items such as engines, generator sets, cranes, ramps, etc., with details about envelope dimensions, capacities, weights, power requirements, etc. The Design Agent usually has catalogs or past experience for fairly common items and requires no direct liaison with the Vendor.

D. Finance Availability. The Owner secures financing for the project. At the same time, he may solicit interest from preferred/qualified shipyards for the construction of the vessel.

E. Bid Package. The Owner issues the bid package to the qualified/preferred shipyards. Historically, U.S. shipyards would market their ability to build vessels of particular types but would not market standard designs. The existence of standard designs would not only put the U.S. shipyards in a more proactive posture, it would also potentially streamline the concept exploration phase of a project.

2.2. Contract Cycle

A. Shipyard Production Evaluates Building Capacity. The shipyard receives the bid package for tender. Planning and Scheduling and the Production Departments evaluate the shipyard's capacity in terms of building slots and the Owner's delivery requirements.

B. Shipyard Technical Evaluation. The Technical Department evaluates the ship design requirements to determine if a standard design can be used or if a new design must be developed. If a new design is required, the shipyard must make a

business decision whether or not to proceed. The design progresses through the various design branches by using either a standard design or a new design. Vendor equipment data is required for unique items as well as for common items for systems level design (for example: flow rates, heat load specification information, envelope dimensions, capacities, weights, power requirements, etc.). The Technical Department usually has catalog data or previous design experience for fairly common items, therefore, little direct liaison is required with the Vendor.

C. Shipyard Estimates Material, Labor, and Production Costs. The Cost Estimating Department includes material, labor, production and delivery in the estimate of the cost of the program. Most estimates are developed parametrically; certain major and unique items are priced individually. VFI is used, as required, in the estimate.

D. Shipyard Planning and Scheduling Proposal Preparation. The Planning and Scheduling Department prepare the proposal and rely upon inputs from the Technical, Production, and Cost Estimating departments to create the schedule. Lead times for major equipment are part of the VFI.

E. Shipyard Proposal. The shipyard submits the proposal based on cost, technical compliance and delivery. All of these are influenced by VFI.

F. Owner/Design Agent Bid Evaluation. The Owner and his technical staff or Design Agent evaluates the different proposals and compares delivery time and total life cycle cost versus revenue.

G. Owner Contract Award. The Owner awards a contract to the winning shipyard.

2.3. Detailed Design Cycle

A. Shipyard Planning & Scheduling Build Strategy. The Shipyard Planning and Scheduling Department, with inputs from the Technical Department and the Production Department, develop a build strategy for the new vessel and present a Detailed Schedule.

B. Procurement Plan. The Procurement Plan is established based upon production needs. Once the needs are known, Purchasing generates a Detailed Schedule.

C. Detailed Schedule. The Detailed Schedule defines when orders are to be placed. These must coincide with Engineering's needs for VFI. This schedule usually lists items having long-lead delivery, which determines ordering sequence.

D. Shipyard Technical Work Packages. The Shipyard Technical Department starts preparing discrete work packages. Common features use standard design details. Unique features are more completely engineered. Catalog cuts and direct inquiries provide interface data. Vendor sales personnel typically keep current catalogs in the hands of designers that commonly use their products. Some vendor equipment is engineered for the specific application (for example: davits, propellers and shafting, gear boxes) and require drawing and other information to be exchanged between the shipyard and the preferred vendors. The work package products are drawings and Bills of Material (BOMs).

E. Technical Vendor Negotiations. Engineering writes Purchase Technical Specifications (PTS) on equipment. These PTS's go to Material Control for screening and then to Purchasing for bids. Once the bids are received, Engineering performs a technical review and sends their recommendations to Purchasing.

These recommendations along with financial considerations lead to vendors that are deemed acceptable. Purchasing begins negotiations with vendors bearing in mind VFI requirements and delivery.

F. Obtain Vendor Data VFI. The purchase order defines the vendor supplied data either as a separate section or inherent within the specification. The purchase order clearly states a definite delivery date of VFI, usually 30-60 days after receipt of order. This VFI is fed back into the technical work packages.

G. Vendor Equipment Data. Vendor data, which was generated in the Contract Design Phase, is now incorporated into drawings and documents that form the basis of the Engineering Design. Changes to VFI in this stage will have a cost impact to the program due to rework of drawings.

H. Drawings. Detailed Design Drawings are produced.

I. Bills of Materials. BOMs are sent to the Purchasing Department. Purchasing obtains quotations and places orders for the items.

2.4. Production Cycle

A. Vendor Equipment Shipping. The Vendor receives the order, produces, and ships the item to the Shipyard.

B. Shipyard Material Control. The item enters the Shipyard's Material Control system for inventory, stocking, and issue.

C. Drawings and BOM. The drawings and BOMs are sent to Planning and Scheduling for coordination with other work in the yard.

D. Shipyard Planning & Scheduling Coordination. Planning and Scheduling generate a work order to Production for the fabrication of a part. Material Control issues the necessary plate, pipe stock, warehoused items, etc.

E. Shipyard Production Module Assembly. Production completes the part and other, related, parts and joins all of them into a module. Additional material and equipment items are issued for installation and pre-outfitting.

F. Shipyard Production Erection. Production erects and completes the modules at the building ways.

G. Shipyard Production Finish, Test & Inspect. Production finishes, tests and inspects the systems within the completed hull. Vendor data or technical assistance may be required for final installation and checkout of equipment.

H. Shipyard Technical Logistics Support Regulatory Compliance. The Technical Department prepares the vessel's documents, provisioning data, and technical manuals based upon the Vendor furnished manuals, logistics data, certificates, etc.

I. Deliver Ship. Completed ship is delivered to owner.

1.

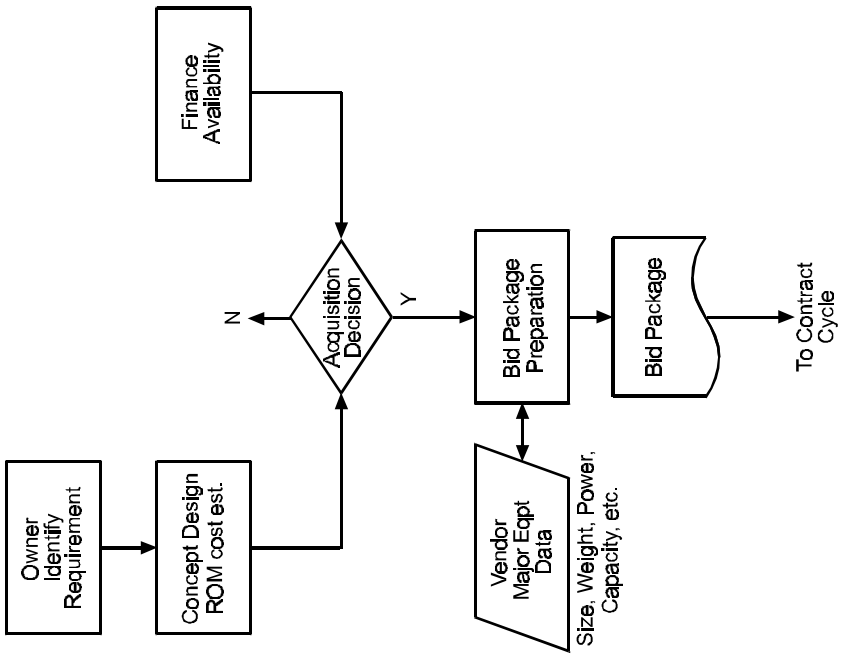
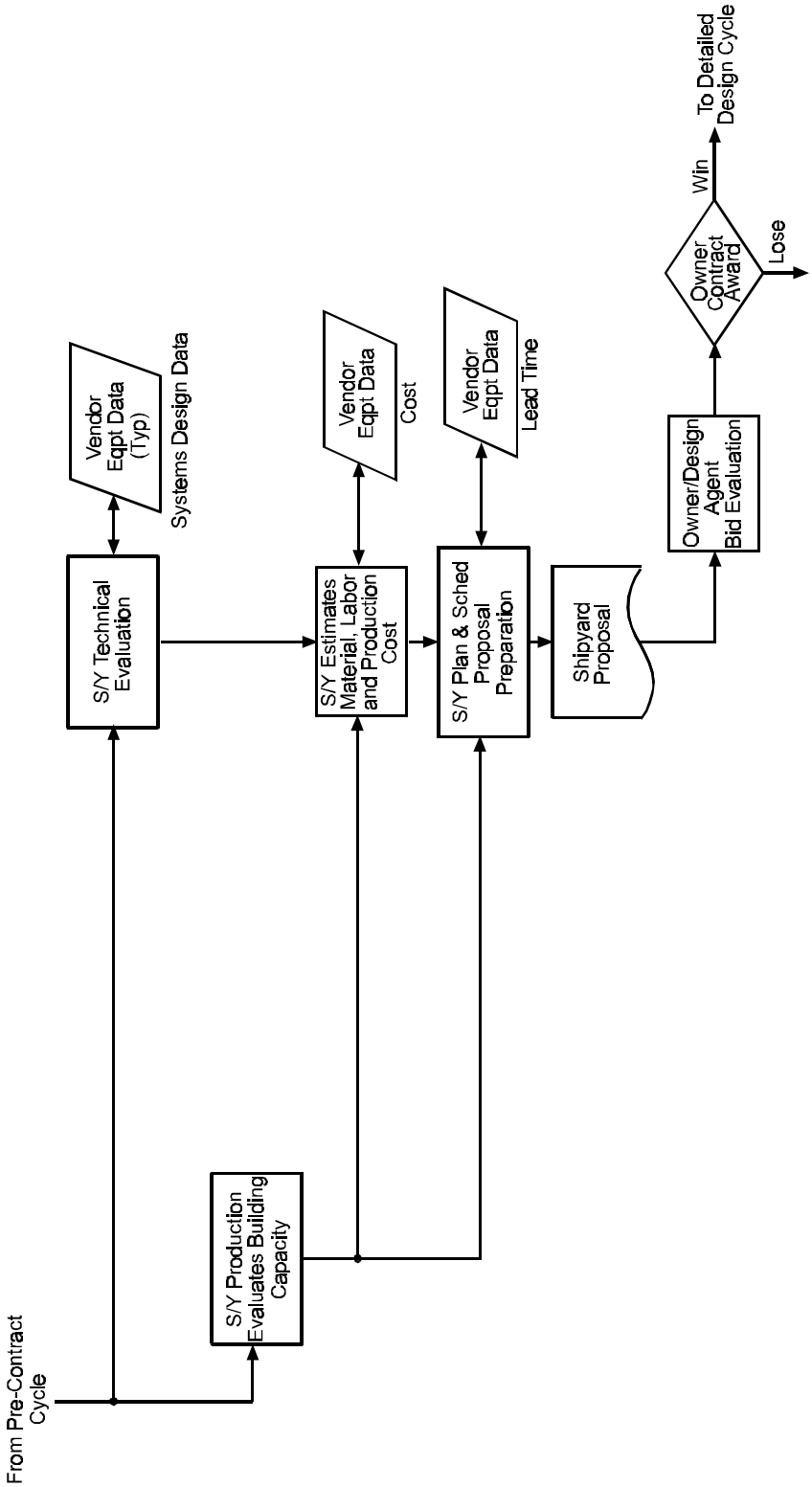


Figure 1a. Typical U.S. Commercial Ship Design Process —Pre-Contract Cycle

Figure 1b. Typical U.S. Commercial Ship Design Process —Contract Cycle



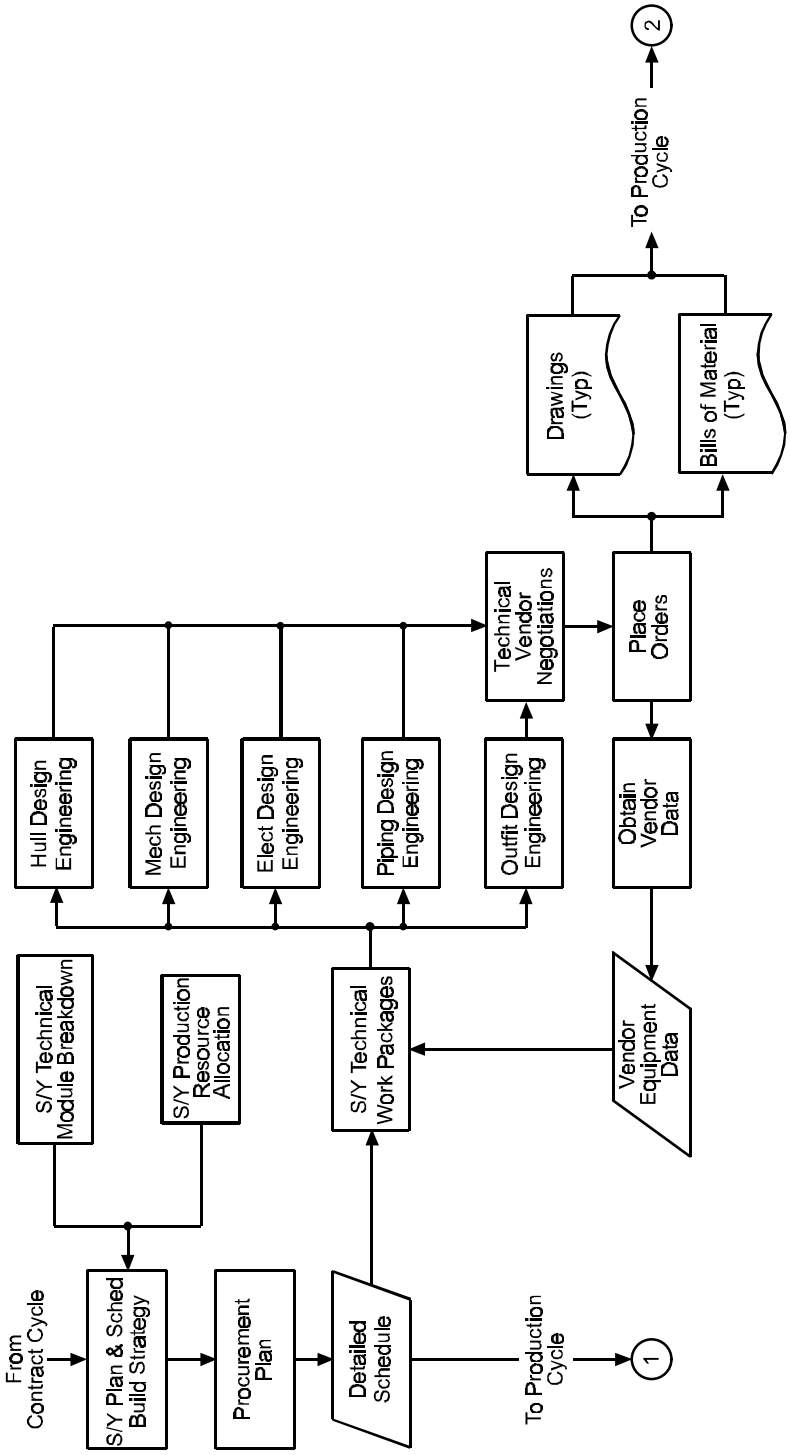
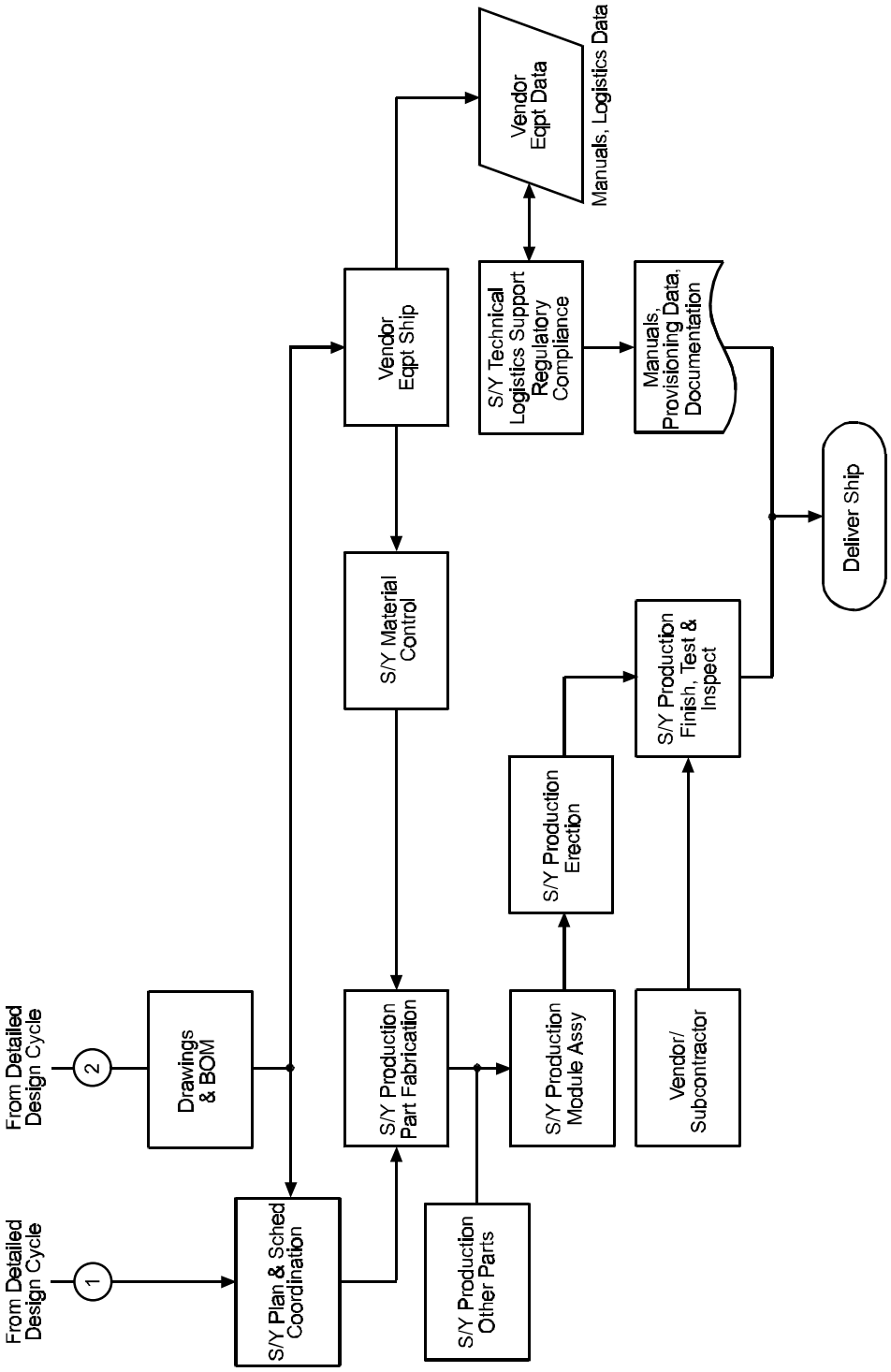


Figure 1c. Typical U.S. Commerical Ship Design Process —Detailed Design Cycle

Figure 1d. Typical U.S. Commercial Ship Design Process —Production Cycle



3. Typical International Design Process

The following discussion of the international ship design process is shown in Figure 2.

3.1. Pre-Contract Cycle

A. Owner Identifies Requirements. There are several reasons why a shipowner makes the decision to place an order for building a vessel. Primarily, all other things being equal, it depends on the owner's identification of a market niche from which he can realize a benefit. If the owner perceives that the capital and operating costs can be more than covered by the expected freight rates over the life of the vessel, he makes the decision to place an order.

B. Owner Performance Specification. Generally the owner produces a performance specification that describes the primary requirements of capacity, speed, manning, range and any features specific to the role of the vessel. The owner leaves it to the competing shipyards to fulfill the requirements at their most attractive price.

C. Order of Costs. The shipowner seeks preliminary prices from the shipyards that he feels are the most competitive or with whom a special arrangement exists or can be made. Internationally competitive shipyards focus on their individual product ranges. They concentrate almost solely on those vessel types by using derivatives of standard designs. The shipowner knows which yards to contact to solicit prices and what the world shipbuilding market is currently demanding.

D. Finance Availability. Finance availability is the main factor affecting the decision of whether to place an order and with whom to place it. Reputable owners generally don't have a problem obtaining financing. The conditions of repayment and the subsidies available influence which yard will receive the contract. Price is only one element of the overall financial model.

E. Acquisition Decision. If the owner decides to proceed, then he starts homing in on the shipyards that have offered the best response to his initial inquiry. At this point, the owner also starts turning his attention to more technical matters and the types of equipment he would prefer.

F. Bid Package. The owner or his shipmanager draws up the bid package in more detail than was required in the initial inquiry. The package includes relevant regulatory requirements and details of the vessel's role. It is unusual for specific vendor equipment to be specified in the bid package unless it is required to fulfill a unique characteristic of the vessel. The owner issues the final bid to the competing shipyards with a deadline for response.

3.2. Contract Cycle

A. Shipyard Strategic Planning. The shipyard receives the bid package and asks the organization to prepare the response. The shipyard starts by evaluating how the order fits into the overall work profile and if that work profile meets with the owner's delivery requirement. If this is positive, then an outline build strategy is produced from either a generic basis or from a similar vessel.

B. Shipyard Technical Evaluation. The shipyard's design departments will develop the technical response to the inquiry ensuring that the functional criteria can be achieved. In addition, they will determine material quantity and price. They also

generate data for major items of vendor equipment and pass it on to the procurement department. Depending on the vessel type and size, this information may be readily available within the shipyard's database and can be applied directly to the project or manipulated to suit the requirement.

C. Procurement Estimates and Timings. A check is made on the price of those vendor items that have the greatest influence on cost and delivery of the vessel to ensure that the build program can be achieved. This is where special arrangements between vendors and shipyards may be exercised to reduce the price to a winning offer.

D. Shipyard Finance Analysis. This is a double function exercise looking both inward and outward. The shipyard assesses the effect of winning the contract in terms of use of the entire facility and that, in turn, directly influences the direct, indirect, and overhead costs, which can be applied to the cost of the vessel. Secondly, the shipyard may offer assistance to the owner to seek the best financial arrangements for borrowing and repayment of the capital cost.

E. Shipyard Estimate. The shipyard will have a high degree of confidence in what the building cost will be through experience of similar past projects if the vessel under consideration is not a novel design. What remains to be determined is what the price must be to win the contract. One element of cost reduction is within the shipyard's relationships with vendors not only in competitive prices but also in the integration of VFI throughout the design and engineering phases. If certified VFI is readily available to the shipyard, then project costs can be reduced.

F. Shipyard Proposal. The shipyard submits the proposal based on cost, technical compliance, and delivery. All of these are influenced to a degree by VFI. Often the time of delivery of the vessel depends upon when a vendor says he will deliver equipment. The technical proposal, in the form of a Build Specification, includes a list of major items of equipment and suppliers. This depends on those vendors with whom the shipyard has formed a relationship either over a period of time or for this specific project. The list forms part of the basis for the price and delivery being offered and the shipyard will protect it ardently.

G. Bid Evaluation. The owner evaluates the bids and awards a contract to the winning shipyard.

H. Contract Award. The financial, delivery, and technical documents are signed off as acceptable to both parties at Contract Award. If all has gone well for the shipyard throughout the negotiation stage, the list of vendors contained within the Build Specification will be intact and so will the VFI to be incorporated into the design. The ramifications to the design and engineering phase, in particular, will be extensive if significant changes occur to the vendor list. Re-engineering increases costs and affects the technical and production programs.

3.3. Detailed Design Cycle

A. Build Strategy/Budgets/Planning. A detailed Build Strategy is produced from either a generic base or a similar vessel. It will describe the methodologies to be adopted during the project and the physical constraints to be imposed. Thus, the technical and production frameworks are set. Budgets based on previous experience are constructed for the total organization including the work content

contained within the build specification. An overall project plan is set and detailed departmental and work area schedules are constructed. All of these assume that VFI is correct and in place in a timely and suitable manner.

B. Vendor Data. The VFI used during the design stage, and incorporated into the key drawings and documents, is further examined, as it becomes the corner stones and building blocks for the engineering phase. Any major changes to this VFI will necessitate rework of the design and have cost and program implications. By now, negotiations should have taken place with all vendors of major items of equipment and the orders have been placed (main engines, power generation, etc.)

C. Technical Plan. Using the VFI for the major items of equipment, the detail drawings, pallet lists and work instructions that drive the production process are developed. In conjunction, the Procurement Department sends out requisitions for newly specified secondary items. Additionally, stock materials and equipment are identified and standards called up for either manufacture (triggering release of additional stock) or procurement. The VFI must be accurate and current and is often maintained within equipment databases, CAD systems, or requested from vendors.

D. Procurement Plan. Pre-contract activities that contain updated costs and delivery time initially drive the Procurement Plan. These must all be confirmed and orders placed ensuring that none of the critical technical details (VFI) have altered. The engineering function now feeds secondary items, stock items and standards into the system. The Procurement Schedule is usually structured such that those items having the longest delivery lead-time are those which are ordered first. This ensures they are incorporated at the correct time in the build sequence as defined by the Build Strategy. Caution must be exercised to obtain VFI for novel items to support the engineering schedule.

E. Technical Commercial Negotiations. Design or engineering personnel procures specified equipment on the basis of the VFI they currently hold. During contract negotiations, but before a commercial agreement is reached, the VFI must be confirmed or changes must be technically accepted and documented. The Procurement and Design/Engineering functions carry this out jointly since changes may effect costs and vice versa.

F. Place Orders. An order is placed when both the vendor and shipyard have reached agreement on technical content and cost. This agreement is clearly defined by way of a specification, a delivery program, and a payment schedule. The delivery program and payment schedule is interlinked and addresses the timing of VFI. The payment schedule and penalties may be heavily weighted towards the supply of VFI when VFI is critical to the success of the project.

G. Obtain Vendor Data VFI. The purchase order defines the vendor supplied data either as a separate section or inherent within the specification. The purchase order clearly states a definite delivery date of VFI. It doesn't state delivery time in terms of duration after some agreed activity or milestone. VFI is critical to the successful execution of the Technical Plan and will be scheduled and expedited within the Procurement Plan.

H. Receive Materials. The purchase orders dictate when Materials are necessary. Delivery schedules are on a Just In Time (JIT) basis or the delivered items are

warehoused. The Procurement Planning system alerts Production Planning to execute a work package.

3.4. Production Cycle

A. Production Plan. The Production Plan framework is set from the Build Strategy and Planning systems information. Detailed workshop schedules are constructed in support of the framework based upon the assumption that the technical information, materials, and equipment flow will be available at the right time.

B. Workshop Loading. Detailed workshop loading is created by combining the engineering outputs of drawings, pallet lists, and work instructions with the information on receipt of materials. All of this information requires accurate VFI as any deficiencies or discrepancies will result in a delay or deviation to the production process.

C. Produce Fabrications. The constituent parts of the vessel are built and sent to the construction site for erection. This assumes that the information, materials and equipment have been routed correctly and on time.

D. Construct Test Commission. During the testing phase of the project, the vessel information reverts from having been presented by unit for production purposes to being presented by area and systems. The constituent elements and equipment are now integrated and expected to perform as specified. Performance is only achieved if the equipment has been installed and maintained to the vendor's recommendations.

E. Technical Support. The design and engineering staff, who specified the equipment and its interfaces and understand what the performance criteria should be, provide technical support. They will produce the systems check-off documentation and provide technical liaison with vendors during the initial operation of equipment to ensure the performance specification is being met.

F. Provision Technical Data. The technical data package is assimilated in support of the delivery of the vessel. This typically consists of certification, documentation, and vendors' manuals for the operation of the vessel in service. The technical/commissioning function compiles the technical data package and again relies on VFI.

G. Vendor Support and Data. The vendor purchase order includes requirements for the support of the equipment during commissioning, trials, and for a period of guarantee. This calls for them to have a representative standing by to initially operate the equipment. The goal is to achieve the specified systems performance. In addition, the vendor is required to demonstrate the ability to support the product for a specified period. When the shipyard passes to the owner the rights under warranty, it is not uncommon for vendors to then make a separate arrangement with the owner covering full life logistical support of the equipment.

H. Deliver Ship. Completed ship is delivered to owner.

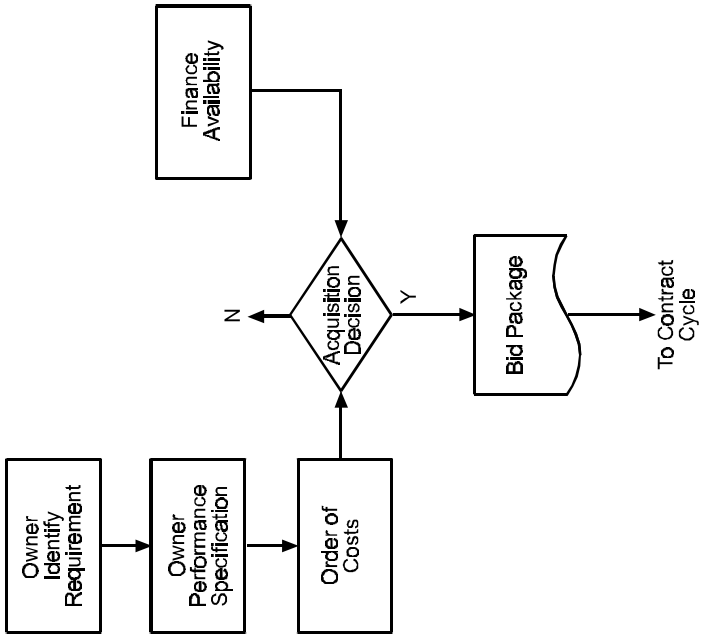


Figure 2a. Typical International Ship Design Process —Pre-Contract Cycle

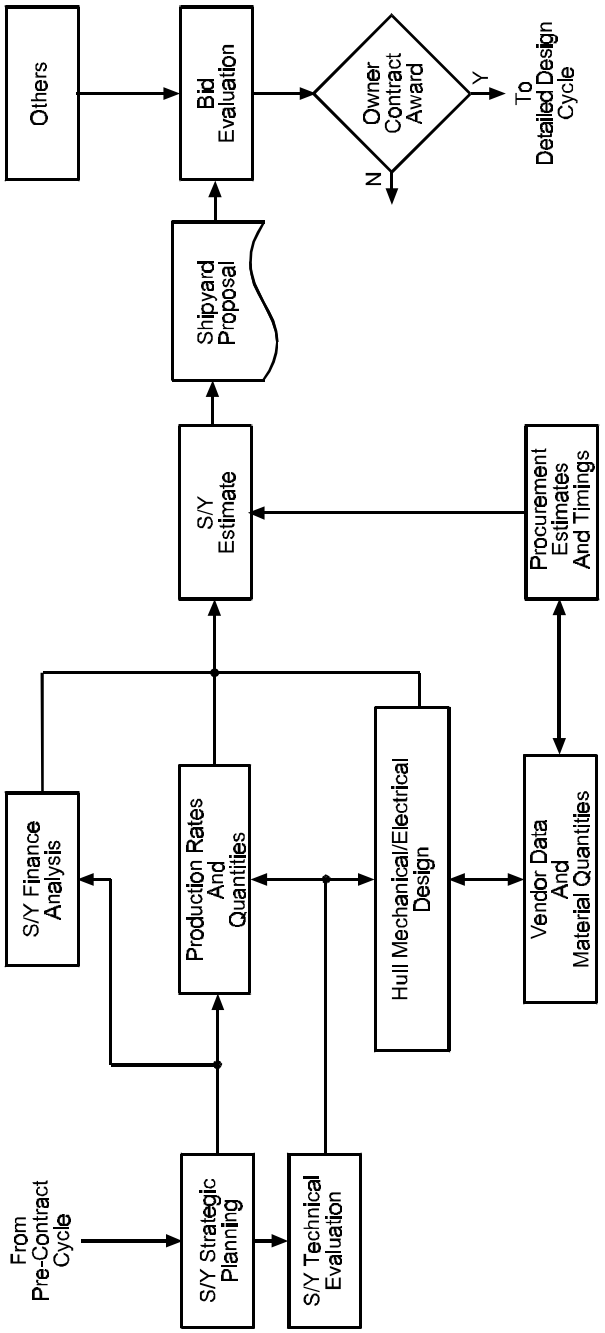


Figure 2b. Typical International Ship Design Process —Contract Cycle

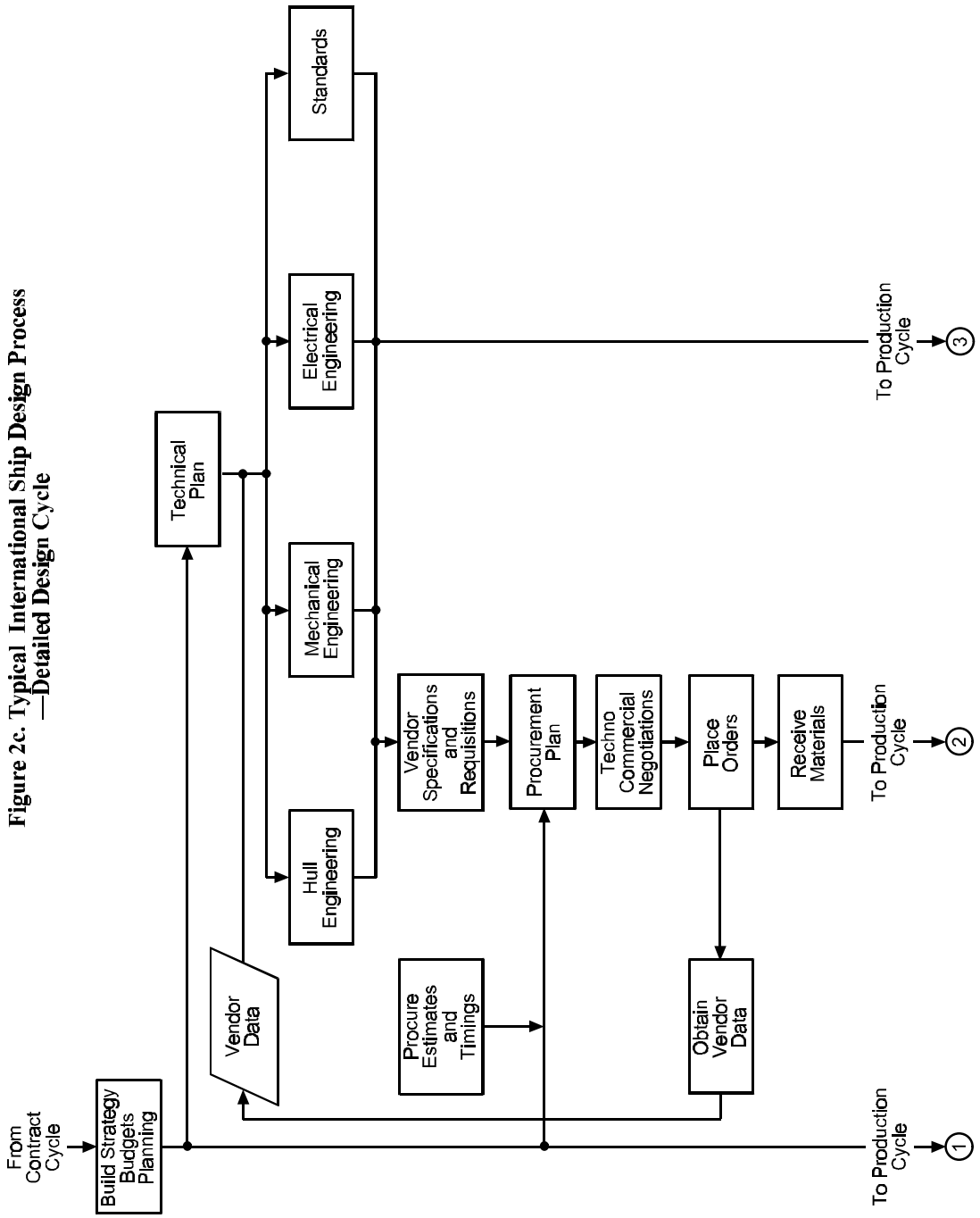


Figure 2c. Typical International Ship Design Process —Detailed Design Cycle

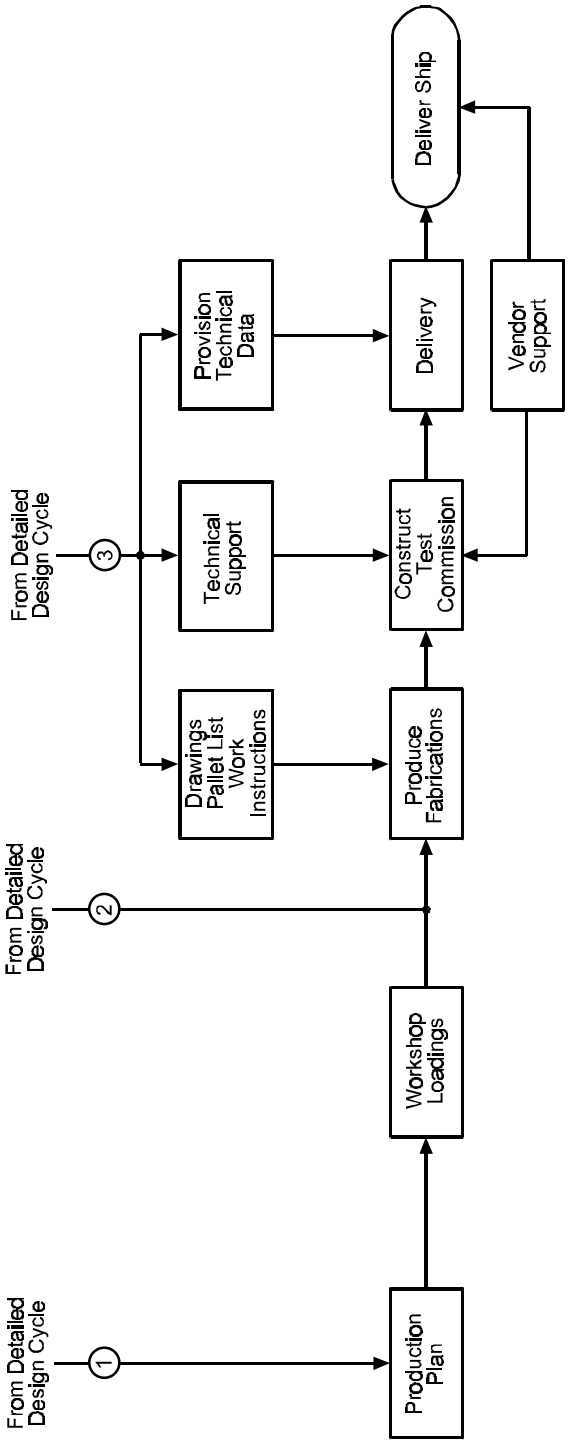


Figure 2d. Typical International Ship Design Process —Production Cycle

4. Comparison of U.S. and European Shipyards Relationships with Vendors and Vendor Furnished Information

U.S. and European shipyard relationships with vendors differ considerably. It appears that the basis for the difference in Vendor Furnished Information is found in the fundamental difference in business relationships and the development and maintenance of shipyard standards in product models. The highlights of the characteristics of the U.S. and European practices are given in the following sections.

4.1. U. S. Practices

1. The shipyards have significant experience in working with DoD and other government projects and little recent experience in dealing with commercial ship owners. Therefore, most shipyard business practices were developed to meet the requirements of DoD and government ship building programs.
2. Short-term (PO to PO) relationships between shipyard and vendors are typical.
3. Shipyards sometimes find it difficult to get information from vendors before the PO is issued.
4. Shipyards put an emphasis on low purchase cost. Experience, however, has shown that the low cost vendor's equipment may be more expensive for the shipyard to implement into the design and that the low cost vendor may also experience difficulties meeting schedule commitments.
5. There is a tendency to encourage competition between a large number of vendors against each other to ensure lowest cost. This practice limits vendors' chances for sales and reduces vendor interest.
6. Communication with the vendor is conducted by telephone, FAX, catalogs, WWW browsers, and 2D CAD drawings.
7. The use of computer technology is limited at present but quickly emerging. Many current shipyard business practices are paper document based. 2D and 3D CAD systems are used for Engineering and Production Engineering. The present configuration is quickly changing to a computer-based system for both engineering data and business data. The exact format and content of the new systems, including supporting data such as Vendor Furnished Information, are still under development.
8. Some current and past problems with vendor data can probably be related to unique U.S. DoD requirements. These include technical data associated with hardware and business rules. When the DoD requirements are greater than the typical commercial practices, the vendor must develop data to meet the DoD requirements, forgo the business, or make a bid and sometimes eventually fail to deliver the required data. This leaves the shipyard to make up the deficiency itself.
9. U.S. shipyards' access to foreign vendors is somewhat limited due to the lack of reliable information on these vendors, their products, and a stable, beneficial, working relationship.

4.2. European Practices

1. The practices described are for purely commercial shipyard operations.
2. The shipyard will have a list of "preferred vendors" around which the contract price and delivery schedule of the vessel has been based. Should the owner wish to deviate from these preferred vendors, there will be cost and schedule implications.

3. The shipyard will vigorously endeavor to protect the “preferred vendors list” since it has built a relationship with these vendors in terms of special discounts and populated a database of information on their products. The shipyard makes extensive use of a preferred vendor database during the bidding and contract phases of a project.
4. Using consistent vendors and systems allows the shipyard to use design data from previous vessels to the maximum extent possible. The design data is contained within the shipyard’s standards. Through the use of these standards, the same or similar components can be identified for incorporation into the engineering drawings for new designs. This allows for early requisitioning and order placement.
5. Standards include a library of blue prints that describe the functions of the systems, the inherent machines and equipment, the performance, the configuration, and the route. They may be accompanied by parts and materials lists along with the vendor’s data and name. The shipyard standards are the cornerstones of the vessel. They contain the outfitting information for the vessel and help to determine which vendors are selected.
6. The list of major equipment in the standards can be ninety-percent generic with the vessel type deciding the remainder. This indicates a very high degree of commonality across ship types.
7. A relationship must exist between the shipyard and its supply chain to allow the standards database to be constantly in the forefront of new developments. This permits the shipyard to have a set of building blocks that can be quickly assembled.
8. The formation and use of the standards database is greatly simplified by the use of computer technology including 3D product models that contain information on component parts.
9. A Fire Protection and Safety Plan will include the identification of vendors. The preferred vendors list will identify those vendors that are offering solutions that are “type approved” by the applicable regulatory authorities and those which receive approval as a matter of course. Tried and proven solutions take precedence over innovative solutions.
10. The shipyards possess “families” of standard pipe banks, machinery modules, equipment modules, transit racks, workshops, and control stations. These are used with as few changes as possible.

5. Conclusion

5.1. Key Issues for Consideration

Based upon the comparison of U.S. and European shipyard practices, the following key issues have been identified for further consideration in the development of the VFI model and the "straw man" for the next phase of this project:

1. The relationship between shipyard and vendors is a key issue. Once this relationship is established, other business practices, such as pricing, delivery schedules, release of proprietary data, the use of Information Technology, CAD data transfer, and EDI can be developed. U.S. yards tend to deal with vendors on a PO to PO basis while foreign yards tend to develop a long-term preferred vendor relationship. This relationship involves qualifying the vendor and granting a commitment for business in return for reduced prices, preference in delivery, and free access to vendor data.

2. Once a working partnership is developed with key vendors, the development of yard standards with 3D CAD and attribute databases is also required for success. The European shipyards' development of mature standards span the entire vessel including structural components, systems and routings, machinery sizes and relationships, equipment positions and configurations, fittings, foundations, and supports. These standards are extremely important in providing the yard with the ability to design and build ships. They are retained in 3D CAD systems at a level of detail that has been refined over time to be adequate, but not over prescribed. Current and accurate vendor data is crucial for the development and maintenance of standards and CAD models. This combination of CAD data and non-geometrical information is properly called a product model. A history of previous designs is inadequate for this purpose as regulatory and owner requirements change. In addition, any advance in the design of vendor equipment will also have an impact on standards outside specific marine considerations.

3. Electronic Data Interchange (EDI) is in its infancy. Presently, U.S. yards are dealing with vendors by telephone, FAX, CAD drawings, e-mail, and limited use of Internet web publishing. Numerous technologies are being created with varying strengths and weaknesses to replace these more conventional methods of communication. The new technologies include publishing vendor data on CD-ROM and the Internet. CD-ROM has the advantage of supplying a large quantity of data to remote sites without any security concerns. The disadvantage of CD-ROM is that the disks become outdated and must be routinely replaced. The live Internet links have the advantage of being inexpensive, universally available, computer platform independent, and always current. They can be expanded to include ordering and payment systems. Their disadvantage is limited bandwidth, down time associated with the Internet, and questions of privacy and security.

4. Few shipyard Information Technology systems include Intranets implemented on a universally integrated basis. CAD design, engineering production, material control, and business control systems tend to be isolated from each other but are growing toward integration. Although European shipyards may be further advanced in some areas, EDI appears to be new territory for all. The application of EDI technology in both Intranets and the global Internet should be considered and applied as the technology matures. It will become a key issue in the future.

5.2. Next Step

The next step in this project will include the development of the following:

1. Develop a strategy that outlines the best methods that can be used by all commercial American shipbuilders. This will involve adapting the International practices to suit the U.S. shipbuilders and their present infrastructure of vendors.
2. Design a model of required VFI for a selected system or subsystem. This will include the major equipment for the system and key vendors. The deckhouse accommodations are one candidate system. Also under consideration are the prime mover and powertrain and the cargo systems for a tank ship or container ship. The relationship between shipyard and vendor will be closely evaluated to determine what format and level of subcontracting best suits the majority of the U.S. industry at this time.
3. Set up a "strawman" for the selected system based upon the VFI requirements, subcontracting, and working relationships defined in number 2 above. This system "strawman" will define the equipment and VFI required. It will also describe the necessary working relationship between the shipyard and the vendor and any third-tier contractors that may be required.

6. Appendix - Interviews With the Marine Industry

As a part of the effort to further define the characteristics of the U.S. ship design/construction process, a number of individuals working for leading shipyards, shipping companies, and design agents were interviewed. The interview questions included a description of VFI, discussion of problems with VFI, and the computer format of the data as received and used within the organization.

6.1. Shipyards

- The maturity and use of a shipyard-wide information technology infrastructure varies greatly. All make use of CAD data to produce drawings. In most instances 3D CAD models are created to be used for design and drawing extraction. The use of a product model that contains CAD data plus additional information about components and assemblies is not universally implemented. Some yards presently possess the capability and other shipyards are moving in this direction. Even those shipyards that employ product model data have found it necessary to employ proprietary system architectures.
- The relationship between shipyard and vendors is defined by purchase orders.
- Sometimes vendor data is collected in the estimating stage from vendors who ultimately do not supply acceptable hardware and software items. These problems arise because vendors are reluctant to return a "no bid" response. Almost all vendors will respond with an affirmative response with no reservations. However, when the time comes for delivery, there may be information deficiencies that require the shipyard to correct the problem at its own expense.
- Other problems with vendors have arisen from software deliverables. This includes drawings, technical manuals, and computer software. Sometimes the problem is the number of copies of each item delivered. The Department of Defense (DoD) requires numerous copies of software items, more than any commercial owner would require. If the vendor does not provide all of the copies, the shipyard must make additional copies at its own expense. Another problem is when technical manuals don't arrive with the equipment. This requires contacting the vendor and chasing down the necessary documentation. It is a time consuming and labor intensive process.
- It is sometimes difficult to get vendor information even when it's specified in the purchase order. Vendors are often slow to supply data that they consider proprietary and are often reluctant to send approved drawings.
- Occasionally there is a disconnection between Estimating and Engineering. Estimating will work with prior examples. Estimating is not always aware of changes in engineering requirements. The result may be that bids are solicited for outdated equipment and must be revised later in the process.
- The Estimating group doesn't have reliable or complete reference lists of foreign vendors. They use Thomas Register or similar references for domestic vendor sources. Similar sources of international vendor data are often lacking.
- Most data requested by estimating is related to cost and schedule. Estimating data is at a different level of data than that required by other groups in the shipyard. The data level is only what is necessary to develop a bid. Estimating data includes cost, availability, best delivery at order date, shipping weight and size required to estimate shipping and handling, (most orders are FOB vendor origin), basic characteristics to ensure the item will meet engineering criteria,

and required electrical power. Geometric configuration and detailed weight data is not usually requested except for large items. The yard needs more information for large items to plan movements and crane lifts in the yard. Data is collected that will affect cost of installation of vendor equipment. For instance, equipment that is skid mounted requires fabrication and installation of subfoundations.

- Some European vendors are slow in the bidding stage to give data other than cost and delivery information. Additional information, however, is readily available once a purchase order is issued. There also is a perception that some European equipment and materials are not available to U.S. shipyards for the same cost offered to European shipyards.
- Program Managers play a role in vendor selection of major equipment. More information in the vendor file would be helpful. Vendor foot dragging can be very expensive. Tracking past vendor performance would assist in the selection process. Information such as product standardization, vendor responsiveness, and whether the equipment meets safety requirements would be a means of quantifying vendor performance and would allow a rational determination of total vendor cost. A lower cost vendor may be more expensive due to poor quality or inability to meet delivery schedules.
- Shipyards have made limited use of a select vendor list. The use of select or preferred vendors needs to be balanced against the concern that the shipyard would not be getting the lowest cost. Often the ship owner has a list of preferred vendors. Dealing with select or preferred vendors will minimize the amount of VFI. Preferred vendors will allow the shipyard to keep files of certified drawings of vendor products on a continuous basis instead of keeping files hull by hull.
- Another consideration is to include the vendors in the estimating process. At present, the vendor estimates are used in developing the shipyard bid, but the vendor is not selected until the contract is signed. Making the vendor a stakeholder could improve interest and pricing. This is presently done for some commercial work. The vendor is always selected after the award for government work.
- In the past, the vendor was subject to penalties for poor performance but no incentives for good performance. The use of incentives may improve the relationship between shipyard and vendor. There is a need to develop a feeling of mutual trust between both parties. Shipyards are interested in expanding the use of vendors who deliver integrated packages instead of individual components. This is preferable to dealing with a large number of vendors whose schedules have to be carefully tracked and where equipment must be integrated into a system devised and maintained by the shipyard. The cost of vendor delay can be expensive but is difficult to calculate. It would reduce the shipyard's risk to use package (single-source) vendors to a greater extent than it does now.

6.2. International Shipyards

Successful international shipyards have the following characteristics in their dealings with vendors with a corresponding impact on the yard infrastructure, information technology, and the ship design itself.

- The shipyard has a list of preferred vendors around which the contract price and delivery of the vessel has been based. Should the owner wish to deviate from this list, there will be cost and schedule implications. Vendors remain on the 'preferred' list providing they remain competitively priced and responsive.

- The shipyard vigorously protects the preferred vendors list since has built a relationship with these vendors in terms of special discounts as well as constructed a database of information on their products. Use of these vendors permits the design to progress very quickly and provides a sound base for the engineering function.
- The list of major equipment can be ninety-percent generic in composition with the vessel type, because of its primary role, deciding the remainder. The additional information regarding the performance criteria of the equipment is required when their unique characteristics are defined. This evolves through the design process but is channeled towards preferred vendors since their products have been well proven and tested and a great deal of basic information is already available to the shipyard.
- Standards are developed and established for use in existing and new designs. These are, in many ways, the drivers which international shipyards use to speed up design time and shorten the overall timeline from feasibility right through to production of engineering drawings. The standards and interim products applicable to the vessel are assimilated in early stages to acquaint the client with what will be built into the product and, more importantly, to form the building blocks for the design and engineering functions that follow.
- The standards span the entire vessel encompassing structural components and configurations, systems and routings, machinery sizes and relationships, equipment positions and configurations, fittings and fixtures, and foundations and supports.
- It is important that the standards are maintained and enforced by the shipyard, not only in the continued development and improvement of the products that will be produced in-house, but also those in which will be bought from vendors and subcontractors.
- A relationship must exist between the shipyard and its supply chain that allows the database to be constantly at the forefront and in line with developments. In this manner, the shipyard will have a set of building blocks that can quickly be assembled to form the required product.
- The formation and use of a standards database is greatly simplified by the use of modern technology. With the capability of creating a three-dimensional product model and capturing all the information applicable to the component parts, the database can easily and quickly be updated for use on the next applicable project.
- Safety requirements lead the shipbuilder to consistently use tried and proven systems, equipment, and materials. The time and expense to adopt innovative solutions very often preclude these from being used in a fixed term contractual arrangement. Within the list of preferred vendors, the shipbuilder will know which vendors are offering solutions that are type approved by the applicable regulatory authorities and which will easily receive approval as a matter of course.
- The shipyard possesses families of standard pipe banks, machinery modules, equipment modules, transit racks, workshops, and control stations. Those standards that can be directly used are plugged into the arrangement. Those that require a degree of modification are worked up within the confines of the originally envisaged space envelope leaving areas to be re-engineered for the remainder of the outfit.
- Many specifications come from standards that have been developed over time. They will be well known to the vendors used and, in some instances, the vendors will be ready to respond almost immediately. This is the result of the shipyard being in contact with their preferred vendors even from the pre-contract inquiry stage.

- The relationship between shipyards and vendors has been progressively changing over the past decade. In the past, shipyards created a technical and commercial competition with as many as five suppliers for each item. This has evolved into an understanding between the shipyard with its preferred vendors. The shipyards reduced staffing levels to reduce overhead costs and hence shipyards now look to the vendor as the expert who will not only supply the kit but also the technical support.
- An understanding is formed with vendors on long term pricing policy that reflects the price the builder can get for a vessel. Therefore, agreement is reached (in simple terms) that if the price of the vessel must fall by a percentage, then the price of the vendors' goods will reflect this and vice-versa. This arrangement is now being taken a stage further by some shipyards in that they now wish for certain vendors to be involved in the pre-contract design and pricing policy. This is on a risk and reward basis particularly where highly complex vessels are being tendered. The risk is that the contract is not placed by the client, the reward being a certain order if it is.
- A teaming arrangement is developing between certain shipbuilders and key vendors where the interfaces between the platform and the equipment must be defined at the conceptual stage. This has resulted in an open book pricing policy. The lead, in certain instances, may even be taken by the vendor.

Fincantiera, SPA s Commercial New Building Shipyard in Monfalcone, Italy

This shipyard is engaged in building the largest cruise ships in the world including the new Carnival Destiny that was ordered at the end of 1993. Nine months later the steelwork was started. Work continued in the building dock for nine months with a total construction time of 23 months, in addition to nine months of engineering. Cruise ships are currently at the outfitting pier for 8-9 months.

- The yard employs 1,480 production workers and 370 white-collar workers, totaling 1,850 persons. The yard relies heavily on subcontractors. For example, they subcontract out 50% of the electrical work. The yard controls all coordination and interfaces while the subcontractors provide material, detail design, and installation labor. The yard typically has 1,200 subcontractor personnel on board during a cruise ship outfitting. These personnel are employed by over 80 subcontractor companies.
- Joiner bulkheads are subcontracted to one contractor, the furniture to another. The cabins are fully mocked-up to establish the standard. All baths are supplied as totally pre-fabricated modules. The yard relies very heavily on subcontractors for engineering, material purchase, and installation. Building times are still getting shorter by customer demand in spite of a highly developed building program and the increasing size and complexity of the ships being built.
- The analysis and selection of material or processes is based upon an understanding of how the parts effect the whole. For example, the structure is designed to facilitate the installation of mechanical and electrical systems. The choice of joiner bulkhead material is based upon the total installed cost to the yard and not just the cost of the bulkhead material.
- Systems are designed only to the point necessary to meet the overall requirements. Much of the detail system arrangement is decided upon by the mechanics at the time of the installation. Typically, the HVAC and piping system's mains, headers, and risers are detailed by engineering while the branch runs are located by the installers within pre-defined service ways.

- The cost of systems is always under review and it is anticipated that what is most cost effective today may not be so in the future. For example, in the case of joiner bulkheads and cabins, Fincantieri is quite sure that currently building the cabins and joiner bulkhead in place out of fiberglass-skin honeycomb panels is less expensive than installing pre-outfitted cabin modules made of merchant-ship type double skin soft core panels.
- Distributed systems are grouped in horizontal and vertical runs, typically in passageways (horizontal) and dedicated trunks (vertical). These systems are restricted to a minimum height above deck to provide an unobstructed space for the installation of modular living spaces.

6.3. The Customer s viewpoint-Shipping Companies

U.S. Shipyards have to look at shipbuilding as the rest of the world does. They can't compete internationally by building ships the way they do now.

- When the operator/owner/future customer realizes a need, the general particulars of the ship are defined by the freight analysis. The operator approaches yards that have a given track record for this size and type ship and determine which yard or yards have openings in their production schedule that match the operator's delivery requirement. The delivery data is critical to the operator because the "needs" analysis targets markets and cargo on a competitive basis well in advance of the delivery date. If the ship is late, the operator may be exposed to serious financial risk as a result of lost freight.
- Japan is the best value country for chemical tankers today when considering quality, price, and reliable delivery. Each Japanese shipyard has its own standard design(s). Any variation results in added cost and extended delivery.

6.4. Suggestions for U.S. Design Agents

It is important to have a clear understanding of VFI during the bid collection stage. Vendor information should include the following:

- Number of manuals and certified drawings required for installation
- Date of equipment availability
- Valid period for proposal and pricing
- Pricing to submit drawings and/or data to ABS/USCG for approval and any other certification
- Equipment weight, dimensions, and center of gravity
- Insurance coverage on equipment quoted
- Vendor financial statement
- Documentation from factory stating that vendor/supplier is a certified dealer
- Location of nearest vendor office
- List of required/recommended spare parts and special tools
- Vendor shall provide adequate copies of drawings for review
- Vendor must indicate any deviations from the specifications

Some additional VFI observations:

- Vendors are typically concerned that a shipbuilder is asking for near propriety information before receiving a purchase order.
- Vendors sometimes request a fee for copies of drawings of their equipment. This is not a recoverable cost.
- Providing data in CAD format would aid in design development.
- Specifications sometimes lag industry. Upon award of contract and purchase of specified equipment, the model of equipment available is different from that which was specified.

6.5. International Vendors

- Parma OY, located in Forssa, Finland, is a manufacturer of engineered prefabricated products for commercial buildings and the marine industry. Products include prefabricated modular cabins and sanitary spaces for hotels and ships. The marine products division that produces marine cabins, wet units, and fire rated doors has recorded sales of 40 million U.S. dollars per year and is growing. Primary markets include Italy and Japan. Parma Oy has supplied five cruise ship sets of cabins to Fincantieri, SPA. The marine division is staffed with 40 office personnel and 130 shop personnel.

  The plant is set up to make panels, doors, and ceiling panels. The products are shipped as individual system components or the components are pre-assembled into modules of cabins and sanitary units. In almost every case, the sanitary spaces are shipped as modules. When Parma assembles the panels into prefabricated module cabins, they use furniture supplied by a subcontractor. All furniture is fastened to and supported by the joiner bulkheads thereby eliminating the need for back panels on the furniture. Cabins are typically 5-sided, i.e., four walls and a full ceiling, less the finished deck.

  Parma supplies pre-fabricated cabins as kits in which all components for individual cabins are packaged together and identified with the exact location for installation on the ship. In some cases, the customer may specify pre-assembled cabin modules. Parma then completes the assembly of the cabins in their plant, including piping, wiring, and ventilation systems, factory tests the systems, and ships the cabins to the customer.

  Parma's cabin system uses the wet unit module as the anchor for the cabin. The wet unit is located so that the service space, which contains the interface connections, isolation valves, and electrical distribution panels, is accessible from the passageway. The wet unit is transferred onto the deck and moved to its final position where it is leveled using adjustable screws and fastened in place by welding. The modular joiner bulkhead panels are progressively assembled around the wet unit until the walls of the cabin unit are complete.

- Norac, AS in Arendal, Norway, is a manufacturer of fire-rated marine joiner doors, bulkheads, and ceiling panels as well as prefabricated modular sanitary spaces. Norac products are marketed under the trade name of Akerpanel. Some shipyards prefer each cabin to be supplied as an independent, pre-fabricated, fully modular unit. As an example, Fincantierai SPA is specifying completely pre-fabricated modular cabins with minimal seams on the bulkheads for their most recent passenger ship orders. Other yards may specify a semi-modular system or tailor made panels. In most cases, the toilet, or wet space, serving the cabin is supplied as a complete factory-made module. Norac has standardized their joiner bulkhead panel width at 600 mm.

- Centraalstaal in Groningen, Netherlands is in the steel pre-processing business. The company prefabricates the more complex, curved, cut, and shaped plates of shell plating. These are delivered to the shipyard ready to assemble with all parts marked per yard drawings and stacked in building sequence. Centraalstaal directly uses the electronic data from the shipyard. This data is reformatted to match the shop equipment with no loss of integrity. The company uses automated plasma cutting and NC controlled cold bending equipment. They claim that the fault percentage has been reduced to just about zero. Centraalstaal works with client shipyards both before and after the shipyard gives a quote to the owner. This allows client shipyards to know precisely the cost for plate shaping.

  The company was established in 1972 when seven shipyards in the northern part of the Netherlands formed a cooperation. The company business has grown to include shipyards in Germany, UK, France, Norway, Belgium, Sweden, Denmark, Spain, Turkey, Poland, Russia, and the Czech Republic. Client shipyards include Blohm & Voss, HDW, Meyer Werft, and Flensburger Schiffbau. They provide plate for ships ranging in size from yachts up to bulk tankers and the largest cruise ships.

APPENDIX B

Master Equipment List (MEL) for Propulsion Equipment, 1/16/98.

Master Equipment List (MEL) for Propulsion Equipment

Sect.	Equipment	Sets	Rating	KW(E)	Remarks
230	Main Diesel Engine	1	4 stroke diesel engine ~500-600RPM	6000	
230	Exhaust Gas Turbocharger & Bypass	1			
230	Air Coolers	1			
230	Governor	1			
230	Engine Spares to Class Requirements	1			
230	Main Engine Turning Gear	1		2	Electric Motor Drive
240	Bow Thruster	1	600 kW	600	Tunnel Type, Hydraulic Drive
240	CPP Propeller	1	120 RPM, 5.5 M. Diam	N	4 Bladed, Controllable Pitch
240	Hyd. Pitch Pumps (CPP)	2			As per CPP Vendor
240	Propulsion Reduction Gear	1	5:1 to 6:1		
240	Propulsion Clutch and Coupling	1			
240	Torsional and Axial Vibration Damper	1			
240	Propulsion Shafting	1			
240	Propulsion Shaft Bearings				
240	Thrust Bearings	1			
240	Bearing Temperature Monitoring System	1			
250	Spare parts and tools for maintenance	1			
250	Galleries on engine with gratings, stanchions, and railings	1			
250	Engine side control console & instrument panel	1			
250	Engine Control Room control console & instrument panel	1			
250	Bridge control console & instrument panel	1			
250	Sensors on engine for Unattended Machinery Space	1			
250	All sensors and monitor stations req'd for integrated control	1			
250	Integrated control and performance monitoring computer software (this system to be integrated with auxiliary systems, power generation, maneuvering system, navigation, communications, firefighting, and with cargo handling. One man bridge operation.	1			
250	Main Engine HT Jacket Water Cooling Pump	2			Vertical, Motor Driven, Centrifugal
250	Main Engine LT Central Fresh Water Pump	2			Vertical, Motor Driven, Centrifugal
250	Uptakes piping including expansion bellows, exhaust gas boiler & silencer	1			
250	Lifting Tools for installation	1			
250	Testing of engine with water brake				
250	Inspection shop trails & sea trails				
250	Diesel engine manufacturer supervision and advisory work (assembly, quay trials, sea trials)				
260	HFO Supply Pump	2			Motor Driven, Rotary
260	HFO Circulating Pump	2			Motor Driven, Rotary
260	HFO Transfer Pump	2			Motor Driven, Rotary
260	HFO Purifier Supply Pump	2			Motor Driven, Rotary
260	HFO Centrifugal Purifiers	2			
260	HFO steam pre-heaters	2			
260	MDO Purifier	1			
260	MDO Purifier Supply Pump	1			Motor Driven, Rotary
260	MDO Transfer Pump	1			Motor Driven, Rotary
260	Camshaft Lub Oil System on engine	1			
260	Camshaft Lube Oil Pump	2			Furnished with Engine
260	Lube Oil Purifier Supply Pump	2			Motor Driven, Rotary
260	Lube Oil Centrifugal Purifier	2			
260	Lube Oil piping on engine				
260	Main Engine Lube Oil Service Pump	2			Motor Driven, Rotary
260	Lube Oil Transfer Pump	1			Motor Driven, Rotary
260	Cylinder Lube Oil Transfer Pump	1			Motor Driven, Rotary
260	Cylinder Lube Oil piping on engine	1			
260	Lube Oil Cooler and Filter	1			
580	Steering Gear	2	50 T-M	15	Electro-Hydraulic, Rapson Slide
580	Steering Gear Support Systems	1			
580	Steering Gear controls	1			
	Optional Equipment for Bid				
240	PTO Gen. Step up Gear	1	10: 1 Ratio	N	Driven From Lineshaft
260	PTO Gear L.O. Pump	2		1	Motor Driven, Rotary
260	SSDG MDO Booster Pumps	2		2	Motor Driven, Rotary
310	Ship Service Generator	3	900 KW		
310	PTO Generator	1	900 KW		

APPENDIX C

Vendor Information Requirements List (VIRL), 1/16/98.

VENDOR INFORMATION

REQUIREMENTS LIST

(V.I.R.L.)

Information To The Vendor

1 Quality Assurance and Quality Control

VIRL NUMBER and DESCRIPTION		REQUIRED DATES				
		With Bid	Draft for review	Final Docs reqd	Delivery with equip	Archived by Vendor
Q01	CORPORATE QUALITY MANUAL Vendor's manual detailing quality policies, procedures and organisation. Quality System Approval Certificate by Accredited Body.	Yes				
Q02	PROJECT QUALITY PLAN Vendor's QA plan detailing organisation and procedures specific to this project.		Yes	4 wks after PO		
Q03	QUALITY INSPECTION AND TESTS Inspection plan indicating specific quality activities - tested by, witness by, etc.		Yes	4 wks after PO		
Q04	PROJECT PLAN A plan is to be submitted for approval showing how and when events are to be achieved from award to shipment. Key dates including documentation issues as required by this VIRL to be shown.		Yes	4 wks after PO		
Q05	PROGRESS REPORTING Monthly progress reports against the project plan are to be provided.		Yes	At PO		
Q06	BUYER'S INSPECTION Items/equipment will be subject to on-site inspection prior to despatch.				Prior to Despatch	

* Note :- Archived by Vendor means that it shall be the responsibility of the Vendor to retain this information for the duration of the Guarantee Period.

2 GENERAL DOCUMENTS

VIRL NUMBER and DESCRIPTION		REQUIRED DATES				
		With Bid	Draft for review	Final Docs reqd	Delivery with equip	Archived by Vendor
G01	VENDOR DATA REGISTER List every document, drawing, manual, calculations, etc. to be submitted in accordance with the requirements of this VIRL including submission dates.	Initial List	4 wks after PO			Yes
G02	GENERAL ARRANGEMENTS List all items and show arrangement of components. Give overall dimensions and withdrawal requirements. Show details of any shipping splits.	Outlines	4 wks after PO	8 wks after PO		
G03	FOUNDATIONS Give details of foundation requirements including bolting arrangements.		4 wks after PO	8 wks after PO		
G04	DATA SHEETS Complete data sheets were applicable providing also sub-supplier information. (Weight Control, Motor Data, Lub Oil Data & Noise Control) Annex A to D.	Outlines		4 wks after PO		
G05	UTILITY CONSUMPTION State utilities required for all cases (normal, peak & emergency) describing the circumstances of each (intermediate, continuous etc.) (air, power, water).	Outlines	4 wks after PO	8 wks after PO		
G06	DESIGN CALCULATIONS Show all design calculations, stating design code used.	Outlines		4 wks after PO		
G07	WEIGHING PROCEDURE Description of equipment to be used for weighing, calibration and method.	Outlines		4 wks after PO		
G08	SEPARATE ITEMS A list of all separate items not packaged with main equipment to be given.	Initial List	4 wks after PO		Final List	
G09	PIPING AND INSTRUMENTATION A schematic diagram showing routing, size, valves, instruments and equipment. Instrument control functions and set points to be given. List all components with Tag Number. to be supplied.	Outlines		4 wks after PO	As Fitted Copies	

VIRL NUMBER and DESCRIPTION		REQUIRED DATES				
		With Bid	Draft for review	Final Docs reqd	Delivery with equip	Archived by Vendor
G10	PIPING CONNECTIONS Details and locations of all piping, valve and instrument connections and terminations		4 wks after PO	8 wks after PO	As Fitted Copies	
G11	INSTALLATION, OPERATION & MAINTENANCE MANUAL Manuals to include erection/assembly drawings and instructions as to the use of tools. Operating procedures for start up, steady state and shut down, emergency and fault conditions to be included. Operating parameters, function of protective devices and controls, block diagrams and fault finding guidelines needed. Also maintenance, disassembly, repair, overhaul and reassemble.		4 wks after PO	8 wks after PO		Yes
G12	COMMISSIONING SPARES List and price of items with full order references as Annex G.				Yes	
G13	OPERATIONAL SPARES Matrix of throughlife spares priced with full order references as Annex E		4 wks after PO	12 wks after PO	Yes	
G14	INSURANCE SPARES List and price of items with full order references as Annex H.		4 wks after PO	12 wks after PO	Yes	
G15	SPARES MANUAL Drawings, lists and exploded views for easy identification. Large spares requiring foundations to be individually identified.	Outlines	4 wks after PO	12 wks after PO		Yes
G16	SPECIAL TOOLS Itemised and priced including calibration. Large tools requiring foundations to be individually identified as Annex F.	Outlines	4 wks after PO	12 wks after PO		
G17	SHIPPING/HANDLING/STORAGE Details and instructions to be clearly given before shipment.			8 wks after PO	Yes	
G18	PRESERVATION & MAINTENANCE Protection, preservation and maintenance instructions from delivery through installation and commissioning to be given, along with validity.			8 wks after PO	Yes	

VIRL NUMBER and DESCRIPTION		REQUIRED DATES				
		With Bid	Draft for review	Final Docs reqd	Delivery with equip	Archived by Vendor
G19	SURFACE PREPARATION & PAINTING All paint systems must be approved by the Buyer prior to application and a report provided prior to delivery.	Outlines	4 wks after PO	8 wks after PO		Yes
G20	HYDROSTATIC/PNEUMATIC TESTS Testing procedure appropriate to specification and prescribed code to be undertaken stating readings to be recorded and instruments used. Method of interpretation of results as basis for acceptance to be described.			4 wks prior to FAT		
G21	FUNCTIONAL TEST PROCEDURE A full Factory Acceptance Test (FAT) procedure to be submitted prior to FAT date.		8 wks prior to FAT	4 wks prior to FAT		
G22	HEAT TREATMENT PROCEDURE Procedure covering pre and post heat treating as applicable.					Yes
G23	CATALOGUES/DATA SHEETS These to include all major features of performance, materials etc. to confirm equipment meets specified requirements.	Outlines	4 wks after PO	8 wks after PO		
G24	COMMISSIONING MANUAL To include sufficient data to enable the Buyer to complete commissioning procedures.		8 wks after PO	12 wks after PO		Yes
G25	NAME PLATE DETAILS Submitted for approval stating equipment name, tag number, operating conditions, manufacturers name, date, inspection authority & buyers identification number.		8 wks prior to despatch	4 wks prior to despat.		
G26	BOLT SCHEDULE Schedule stating number off, size, material, and torque setting of all fixing bolts.		4 wks after PO	8 wks after PO		
G27	FOUNDATION LOADINGS Information on static, dynamic and transportation forces.	Outlines		4 wks after PO		

VIRL NUMBER and DESCRIPTION		REQUIRED DATES				
		With Bid	Draft for review	Final Docs reqd	Delivery with equip	Archived by Vendor
G28	MECHANICAL SEAL DETAILS Drawing to give cross-section, clearance and dimensions of seals along with parts list and materials against which spares can be ordered.			12 wks after PO		
G29	HEAT EMISSION Calculations determining heat emission for various loadings within the environmental conditions as specified.	Outlines	4 wks after PO	8 wks after PO		

3 ELECTRICAL DOCUMENTS

VIRL NUMBER and DESCRIPTION		REQUIRED DATES				
		With Bid	Draft for review	Final Docs reqd	Delivery with equip	Archived by Vendor
E01	EQUIPMENT LIST List all items of electrical equipment giving details of quantity, manufacturer, type number, certification type, apparatus group, temperature class, type approval certificate number and authority.	Outlines	4 wks after PO	8 wks after PO		Yes
E02	GENERAL ARRANGEMENT List all electrical items and give dimensions. Give terminal box locations, cable entries, cable size, entry threads and location of earthing.	Outlines	4 wks after PO	8 wks after PO		Yes
E03	WIRING DIAGRAMS Display in block form the items of equipment and the cables connecting them. Terminal block reference shall be stated for each item along with the number and size of each conductor. Cables not being supplied to be clearly identified.		4 wks after PO	8 wks after PO		
E04	POWER AND LIGHTING CABLE SCHEDULE Give cable types, sizes, lengths and terminations.		4 wks after PO	8 wks after PO		
E05	ELECTRICAL SCHEMATICS Show full control logic illustrating component identification legend and setting ranges for all protective devices.		4 wks after PO	8 wks after PO		
E06	CIRCUIT SCHEDULE Give cable types, sizes, lengths and terminations.		4 wks after PO	8 wks after PO		
E07	LAYOUT DRAWINGS Show location of all equipment, sized cable trays, junction boxes, routes, cable entry and connection point details.	Outlines	4 wks after PO	8 wks after PO		
E08	PROTECTION DEVICES OPERATING CURVES To be provided for all devices.			8 wks after PO		

VIRL NUMBER and DESCRIPTION		REQUIRED DATES				
		With Bid	Draft for review	Final Docs reqd	Delivery with equip	Archived by Vendor
E09	ELECTRICAL CONSTRUCTION DRAWINGS Show construction details and components such as busbars, loop-wiring channels and cut-outs etc.		8 wks after PO	With Equip		
E10	ELECTRICAL PERFORMANCE DATA Give details of operating data for all major and auxiliary equipment.	Outlines	4 wks after PO	8 wks after PO		

4 INSTRUMENTATION DOCUMENTS

VIRL NUMBER and DESCRIPTION		REQUIRED DATES				
		With Bid	Draft for review	Final Docs reqd	Delivery with equip	Archived by Vendor
J01	LOGIC CAUSE & EFFECT DIAGRAM Show causes to system trips or shutdowns and resulting effects and actions.		4 wks after PO	8 wks after PO		
J02	SOFTWARE SYSTEM Show philosophy of system		4 wks after PO	8 wks after PO		
J03	INSTRUMENT LEGEND DIAGRAMS Clearly identify field and panels layouts.		4 wks after PO	8 wks after PO		
J04	HOOK-UP DIAGRAMS Show all pneumatic, hydraulic, electrical, electronic and process hook-ups.		4 wks after PO	8 wks after PO		
J05	LOOP DIAGRAMS Full electronic system wiring loops showing panel terminations and connections and all relevant control and indication components.		4 wks after PO	8 wks after PO		
J06	LAYOUTS Show all pneumatic and hydraulic layouts and routings.		4 wks after PO	8 wks after PO		
J07	CONTROL SCHEMATICS Show full control logic illustrating all normal and emergency functions.		4 wks after PO	8 wks after PO		
J09	CONTROL PANEL LAYOUT Fully dimensioned internal and external layout with detailed parts list.		4 wks after PO	8 wks after PO		
J10	CONTROL PANEL CONSTRUCTION Fully dimensioned fabrication drawings showing any cut-outs for drop-in instruments.		4 wks after PO	8 wks after PO		
J11	MOUNTING EQUIPMENT DRAWING Fully dimensioned internal and external drawings showing mounting details for any applicable equipment.		4 wks after PO	8 wks after PO		

VIRL NUMBER and DESCRIPTION		REQUIRED DATES				
		With Bid	Draft for review	Final Docs reqd	Delivery with equip	Archived by Vendor
J12	INSTRUMENT SCHEDULE This is to be produced to complement the instrumentation diagrams after loop numbers have been added. The minimum information to be included shall be tag numbers, instrument description (switch, control valve, level gauge etc.) and service description.		4 wks after PO	8 wks after PO		
J13	INSTRUMENT LOCATION A layout drawing is to be provided showing the position of each instrument.		4 wks after PO	8 wks after PO		
J14	INSTRUMENT SPECIFICATION For each instrument the Material specification, manufacturer, model number, calibration and test certificate is to be provided.		4 wks after PO	8 wks after PO		
J15	HOUSING AND WINTERISATION Any special instructions to be provided.			8 wks after PO		
J16	CABLE LAYOUT Layout of all field cabling showing location of all instruments, sized cable trays, junction boxes, routes, cable entry and connection point details.		4 wks after PO	8 wks after PO		

5 CERTIFICATION DOCUMENTS

VIRL NUMBER and DESCRIPTION		REQUIRED DATES				
		With Bid	Draft for review	Final Docs reqd	Delivery with equip	Archived by Vendor
C01	MATERIAL CERTIFICATIONS Independent Inspection Certificates and Test Reports.			4 wks before deliver		Yes
C02	TYPE TEST CERTIFICATES By Internationally Accredited Authority.			4 wks before deliver		Yes
C03	HAZARDOUS AREA CLASSIFICATION CERTIFICATES By Certifying Authority			4 wks before deliver		Yes
C04	INGRESS PROTECTION CERTIFICATION By Certifying Authority.			4 wks before deliver		Yes
C05	CONFORMITY CERTIFICATION Attesting conformity to type approval.			4 wks before deliver		Yes
C06	FIRE SAFE CERTIFICATION By Certifying Authority.			4 wks before deliver		Yes
C07	MATERIAL LOCATION PLAN Cross reference between material placement and material certificates.					Yes
C08	WELDING PROCEDURES Specifications and repair procedures.					Yes
C09	WELDER QUALIFICATION RECORD For nominated welders for subject process to applicable procedure.					Yes
C10	NDT PROCEDURES For X-ray, MPI, DPI and UT.					Yes
C11	NDT OPERATOR QUALIFICATIONS To recognised approved bodies for processes to be undertaken.					Yes
C12	WELD AND NDT RECORDS Record sheets and annotated drawings with cross reference between locations, procedures, welder ID, qualifications and NDT reports.			4 wks before deliver		Yes
C13	DIMENSIONAL CONTROL PROCEDURE Describing methods to be used.			4 wks before deliver		Yes
C14	DIMENSIONAL CONTROL REPORT In accordance with procedure.			4 wks before deliver		Yes

VIRL NUMBER and DESCRIPTION		REQUIRED DATES				
		With Bid	Draft for review	Final Docs reqd	Delivery with equip	Archived by Vendor
C15	FURNACE CHARTS For each heat treatment					Yes
C16	PRESSURE TESTS Reports and certificates in accordance with statutory requirements for equipment and component parts (valves, bellows etc)			4 wks before deliver		Yes
C17	FACTORY FUNCTION TEST Reports, certificates and charts in accordance with statutory requirements.			4 wks before deliver		Yes
C18	FACTORY ACCEPTANCE TEST Performance report, certificates and charts in accordance with statutory requirements.			4 wks before deliver		Yes
C19	SPEED/TORQUE CURVES At 80% and 100% rated voltage.			4 wks before deliver		Yes
C20	SHORT CIRCUIT TEST CERTIFICATE Issued by Accredited Authority					Yes
C21	MOTOR TEST CERTIFICATION In accordance with statutory requirements.					Yes
C22	CABLE CONTINUITY AND RESISTANCE TEST Test report.					Yes
C23	DYNAMIC BALANCE REPORT Showing concentricity/run out values and dynamic balance achieved in each plane.					Yes
C24	PROOF LOAD TEST CERTIFICATE Showing design load, proof load and safe working load.					Yes
C25	CALIBRATION TEST CERTIFICATES Records of test instruments etc. used for testing.					Yes
C26	CERTIFIED MARKINGS Equipment to be stamped/annotated as acceptable to certifying authority.					Yes

WEIGHT CONTROL DATA SHEET

ANNEX A

SHIP NUMBER :-	
SUPPLIER NAME :-	
ORDER NUMBER :-	
MATERIAL NUMBER :-	
EQUIPMENT NAME :-	
TAG NUMBER :-	

TOLERANCE NOTES

CATALOGUE WEIGHT	
PRELIMINARY ESTIMATE	
FINAL WEIGHT	

DIMENSIONAL DATA

SKETCH OF EQUIPMENT TO BE PROVIDED SHOWING DATUMS

OVERALL DIMENSIONS

LENGTH :-	
BREADTH :-	
HEIGHT :-	

CENTRE OF GRAVITY

	DRY	**OPERATING**
X		
Y		
Z		

VERIFIED		**DATE**	

ONE SHEET TO BE COMPLETED FOR EACH INDIVIDUAL BUYER MATERIAL NUMBER WITHIN THE SCOPE OF SUPPLY

MOTOR DATA SHEET

ANNEX B

SHIP NUMBER :-	
SUPPLIER NAME :-	
ORDER NUMBER :-	
MATERIAL NUMBER :-	
EQUIPMENT NAME :-	
TAG NUMBER :-	

1	Manufacturer:	21	Duty Point Efficiency:
2	Number Off:	22	Starting Current:
3	Starting Method:	23	Starting Power Factor:
4	Continuous Rating:	24	Starting torque
5	Motor Speed:	25	Max. No. Starts Per Hour:
6	Full Load Current:	26	Max. Run-Up Time Coupled
7	Rated Power Factor:	27	Heater Rating:
8	Full Load Efficiency:	28	Heater Supply (V/PH/Hz):
9	Full Load Torque:	29	Thermistor Fitted (Yes/No)
10	Supply Details (V/PH/Hz):	30	Coupling:
11	Ingress Protection:	31	Mounting:
12	Ambient Temperature:	32	Frame Size:
13	Insulation Class:	33	Serial Number:
14	Temperature Class:	34	Weight:
15	Winding Connection;	35	Certificate Number:
16	Duty Cycle:	36	Number Of Bearings:
17	Duty Point Rating:	37	Type Of Bearing:
18	Duty Point Absorbed Kw:	38	Make Of Bearing:
19	Duty Point Absorbed KVAR:	39	Lubrication:
20	Duty Point Power Factor:	40	Bearing Ref.:

VERIFIED		**DATE**	

ONE SHEET TO BE COMPLETED FOR EACH INDIVIDUAL BUYER MATERIAL NUMBER WITHIN THE SCOPE OF SUPPLY

LUBRICATING OIL DATA SHEET

ANNEX C

SHIP NUMBER :-	
SUPPLIER NAME :-	
ORDER NUMBER :-	
MATERIAL NUMBER :-	
EQUIPMENT NAME :-	
TAG NUMBER :-	

EQUIPMENT NAME	LUBRICATION SPECIFICATION	APPLICATION	INITIAL CHARGE	CONSUM RATE	FREQ of CHANGE

VERIFIED		**DATE**	

ONE SHEET TO BE COMPLETED FOR EACH INDIVIDUAL BUYER MATERIAL NUMBER WITHIN THE SCOPE OF SUPPLY

NOISE DATA SHEET

ANNEX D

SHIP NUMBER :-	
SUPPLIER NAME :-	
ORDER NUMBER :-	
MATERIAL NUMBER :-	
EQUIPMENT NAME :-	
TAG NUMBER :-	

UNSILENCED EQUIPMENT DATA									
	Overall	OCTAVE MID-BAND FREQUENCY							
	dB(A)	63	125	258	500	1K	2K	4K	8K
Sound Pressure Level @ 1 m									
Sound Power Level									
Narrow Band/Impulse Noise									
SILENCED EQUIPMENT DATA									
	Overall	OCTAVE MID-BAND FREQUENCY							
	dB(A)	63	125	258	500	1K	2K	4K	8K
Sound Pressure Level @ 1 m									
Sound Power Level									
Narrow Band/Impulse Noise									

VERIFIED		**DATE**	

ONE SHEET TO BE COMPLETED FOR EACH INDIVIDUAL BUYER MATERIAL NUMBER WITHIN THE SCOPE OF SUPPLY

SPARES LIST

ANNEX E

SHIP NUMBER :-	
SUPPLIER NAME :-	
ORDER NUMBER :-	
MATERIAL NUMBER :-	
EQUIPMENT NAME :-	
TAG NUMBER :-	

Working No. Per Set	
Depot No. Per Set	
Description	
Re-Ordering No.	
Price	
Remarks	
Supplier's Spares Department Address: Telephone: Fax:	

VERIFIED		**DATE**	

ONE SHEET TO BE COMPLETED FOR EACH INDIVIDUAL BUYER MATERIAL NUMBER WITHIN THE SCOPE OF SUPPLY

TOOLS LIST

ANNEX F

SHIP NUMBER :-	
SUPPLIER NAME :-	
ORDER NUMBER :-	
MATERIAL NUMBER :-	
EQUIPMENT NAME :-	
TAG NUMBER :-	

Working No. Per Set	
Depot No. Per Set	
Description	
Re-Ordering No.	
Price	
Remarks	
Supplier's Spares Department Address: Telephone: Fax:	

VERIFIED		**DATE**	

ONE SHEET TO BE COMPLETED FOR EACH INDIVIDUAL BUYER MATERIAL NUMBER WITHIN THE SCOPE OF SUPPLY

COMMISSIONING SPARES LIST

ANNEX G

SHIP NUMBER :-	
SUPPLIER NAME :-	
ORDER NUMBER :-	
MATERIAL NUMBER :-	
EQUIPMENT NAME :-	
TAG NUMBER :-	

Working No. Per Set	
Depot No. Per Set	
Description	
Re-Ordering No.	
Price	
Remarks	
Supplier's Spares Department Address: Telephone: Fax:	

VERIFIED		**DATE**	

ONE SHEET TO BE COMPLETED FOR EACH INDIVIDUAL BUYER MATERIAL NUMBER WITHIN THE SCOPE OF SUPPLY

INSURANCE SPARES LIST

ANNEX H

SHIP NUMBER :-	
SUPPLIER NAME :-	
ORDER NUMBER :-	
MATERIAL NUMBER :-	
EQUIPMENT NAME :-	
TAG NUMBER :-	

Working No. Per Set	
Depot No. Per Set	
Description	
Re-Ordering No.	
Price	
Remarks	
Supplier's Spares Department Address: Telephone: Fax:	

VERIFIED		**DATE**	

ONE SHEET TO BE COMPLETED FOR EACH INDIVIDUAL BUYER MATERIAL NUMBER WITHIN THE SCOPE OF SUPPLY

APPENDIX D

Analysis of Shipyard and Vendor Responses to VIRL/MEL Questionnaire, 5/26/98.

Analysis of Shipyard and Vendor Responses to VIRL/MEL Questionnaire 5/26/98

1. Introduction

In February 1997 the National Shipbuilding Research Program (NSRP) Panel SP-6 tasked Avondale Industries Inc. to develop guidelines for the timely and accurate transfer of information between vendors and shipyards during the ship acquisition process. M. Rosenblatt & Son, along with Harland and Wolff, are subcontractors to AII in this project. The goal of this work is to reduce the time for the design, acquisition, construction, and repair process in the U.S. shipbuilding industry.

- **Master Equipment List**. To accomplish this end, a Master Equipment List (MEL) for Propulsion Equipment Strawman was developed (Attachment 1). This document includes all of the propulsion machinery and the electrical service equipment for a typical 15,000 DWT tank ship. This list is organized using the U. S. Navy Ship Work Breakdown (SWBS) system. A detailed description of the MEL is given in section 2.1 of this report.

- **Vendor Information Requirements List**. In addition to the MEL, a Vendor Information Requirements List (VIRL) was developed (Attachment 2). The VIRL is a template foe specifying the delivery of vendor information. It was developed from the shipyard perspective and describes information that the shipyard requires during a typical ship design and construction process. A detailed description of the VIRL is given in section 3.1 of this report.

Copies of the Propulsion Equipment MEL and the VIRL specification were sent to several U.S. shipyards, domestic equipment vendors, and foreign equipment vendors. These companies were asked to assess these documents by responding to a list of questions. Responses were received from three shipyards, four marine engine vendors, and five general marine vendors. These responses have been compiled and analyzed in this report.

2. MEL for Propulsion Equipment

This section describe the contents of the MEL and the survey questions given to the shipyards and vendors.

2.1 Description of the MEL

The Propulsion Equipment MEL is organized using the U. S. Navy Ship Work Breakdown Structure (SWBS). The MEL includes all of the group 200 propulsion equipment and the group 310 electrical service generators items for a typical 15,000 DWT tank ship. This notional ship is equipped with a 6000 kW medium speed diesel engine operating through a reduction gear driving a 5.5 meter controllable pitch (CPP) propeller at 120 rpm. The propulsion suite includes all group 230 equipment including the propulsion engine and ancillary equipment such as exhaust gas turbocharger, air coolers, governor, spares and turning gear. The group 240 equipment includes a 600 kW bow thruster, CPP propeller with auxiliary equipment, shafting, bearings, and instrumentation. Group 250 includes spares, galleries, controls, sensors, and integrated controls in engine room and bridge. These controls are approved by classification societies for one man bridge operation. Group 260 includes all necessary pumps and purifiers for Heavy Fuel Oil, Marine Diesel Oil, and lube oil. Group 580 includes steering gear and auxiliary equipment. Optional equipment for bid included Group 310 with a 900 kW ship service electrical generator and a 900 kW Power Take-off (PTO) shaft or gear-box driven generator.

2.2 Survey Questions Regarding the MEL

The shipyard and vendor participants were asked the following questions regarding the MEL:

> Question 1. How would your organization respond to a bid on the MEL Strawman? Would you be prepared or interested in contracting for this suite of equipment as a single purchase order? For vendors this does not mean it is necessary to manufacture all of the equipment, but that your organization would act as the prime contractor assembling subcontractors as necessary.
>
> Question 2. If a single purchase order is too extensive, how would you bundle this equipment into suites for bid?

The responses to these questions are compiled in section 4.0.

3. Vendor Information Requirements List

This section describe the contents of the VIRL and the survey questions given to the shipyards and vendors.

3.1 Description of the VIRL

The VIRL is a template for specifying the delivery of vendor information. It was developed from a shipyard perspective and describes information that the yard requires and the phase of the ship design/construction project when the information is needed. In theory, the request for bid sent to the vendor would have the VIRL attached with the required data specified. The VIRL document lists the vendor data required by the shipyard for a typical construction program. The VIRL is divided into the following sections:

Section 1. Quality Assurance and Quality Control
Section 2. General Documents
Section 3. Electrical Documents
Section 4. Instrumentation Documents
Section 5. Certification Documents
Section 6. Supporting Data Sheets and Lists

Each of the first five sections of the VIRL lists equipment data items and the required dates for submission of these items to the shipyard. The ship program phases included bid, draft for review, final documents, equipment delivery, and data archived with the vendor. Dates were listed in the VIRL as examples of typical shipyard schedule requirements.

3.2 Questions regarding the VIRL

The shipyards and vendor were requested to review the VIRL and answer the following questions regarding the usefulness of this document.

> Question 3. If you accepted a contract for propulsion equipment, could you meet the information requirements? Where would you have difficulty? What more would you need to know from the shipyard?
>
> Question 4. How could this VIRL be improved?

The responses from these questions are compiled in section 5.0.

4. Vendor/Shipyard Relationship

In addition to the specific questions on the MEL and the VIRL, the participants were asked to comment on the vendor/shipyard relationship itself. The participants were asked if the prospect of closer vendor/shipyard relationships was of interest. A closer relationship implies that a small group of vendors would have an increased chance of making sales with a given shipyard. In return for preferred consideration, these vendors would provide advance and normally proprietary information. This information would allow the shipyard to pre-qualify the vendor and use this information in developing potential designs. With this close vendor/shipyard relationship, the question becomes how a document, such as the VIRL, could be utilized. The following questions were asked regarding the vendor/shipyard relationship:

> Question 5. From the prospective of your organization, how could a preferred vendor relationship be established?
>
> Question 6. Is this scenario appealing to your organization? If so, what aspects of this relationship are most important to you?

The responses from these questions are compiled in section 5.0.

5. Compilation of Responses

In order to provide the response in context, the results have been compiled by shipyard view and vendor view. The text of the responses are given below with an analysis in the following section.

Questions	Response Shipyard A	Response Shipyard B	Response Shipyard C
MEL for Propulsion Equipment			
1. Would you contract all of MEL as a single suite?	No.	Only if market indicated this would be least cost and most effective from a life cycle view.	No.
2. Would you bundle into smaller packages for bids?	Yes, as follows: • Bow Thruster • Steering Gear & Support • Main Engine package with ancillary equipment.	Would consider these factors: • Logical sequence of mounting related requirement on skid or raft. • Inter-relationships for proper system operational warranty. • High risk interfaces.	• Have tried to mount system equipment on common foundations. Have not found vendors to provide as unit. • Achieving better pricing asking for quotes on components rather than package. • Package equipment in house rather than pay overhead of packaging vendor. Internal costs associated with equipment purchase not readily visible, therefore it appears to be less expensive to procure components.
VIRL			
3. How could vendors meet information requirements? Where would there be difficulties? What would vendor need to know about the shipyard?	NA	NA	Have doubts that vendors are able to satisfactorily provide data needed by shipyard.
4.. How could VIRL be improved?	• Add Milestone Payment Requests • Add Contractual Requirements for Class	• No problem with data items in VIRL. • May be specific issues in engineering functional disciplines responsible for equipment. • Schedules in many cases will not accommodate multiple equipment packaging by single vendor, especially for developmental items.	• Provide more detailed explanations of data needed. Possibly in appendix. What are Key Quality Characteristics? How can vendor determine if he meets contract requirements? • Require more data up front (quality and price impact.)

Questions	Response Shipyard A	Response Shipyard B	Response Shipyard C
			• Lead times insufficient unless "off the shelf" item. • Significant amount of data (vendor test, heat treatment, welding, NDT, dimensional control, worker qualification, calibration certificates) not needed by shipyard or ship owner. Delete information not required to certify, install, operate or maintain. • Certificates should identify authority and provide reference. • Group data required for regulatory submission.
Vendor/Shipyard Relationship Scenario of vendor/shipyard relationship with a controlled specification such as the VIRL			
5. How could preferred vendor relationship be established?	• Add Vendor to Maker's List. • Pre-qualification of Vendor. • Mutual relationship with sharing of responsibilities between parties.	• Preferred vendor relationships useful only if cost/service/information effective. • Useful special contract items include extended warranties, special service arrangements, spares, stocking, collaborative design agreements, lower tier consortiums, and other considerations.	
6. Is this scenario appealing to your organization? What aspects are most important?	Definitely appealing. Most important aspects are engineering and design support as well as after-sale support.	• Appealing under conditions noted. • Ability of supplier to assist in leveraging cost, customer service, and cycle time very important. • Ability to collaborate in design and minimize various types of cost exposure and technical risk are market differentiators.	
Other Comments.	VIRL is very through and a good tool for the shipyard. Requested copy of VIRL.		• Problem is not lack of data, but lack of understanding of details needed by shipyard, both inside shipyard and by

Questions	Response Shipyard A	Response Shipyard B	Response Shipyard C
			vendors. • Shipyards may be better served by following other industries than create their own standards. • What data available from regulatory and certifying authorities to simplify approval? Have had difficulty identifying specific ABS and USCG requirements. • What vendors provide packages data per the MEL? Are they able to provide data quicker than shipyard dealing directly with component manufacturers? • What type of processes do "world class shipyards" use re: VFI? Have other industries been benchmarked?

Questions	Response Engine Vendor A	Response Engine Vendor B	Response Engine Vendor C
MEL for Propulsion Equipment			
1. Would you contract all of MEL as a single suite?	Yes. Vendor would provide own equipment for main engines, generator sets, and direct auxiliary support. Vendor would subcontract the balance.	No.	Yes, but not everything. Some items such as steering gear and associated ancillary equipment is outside of scope of supply.
2. Would you bundle into smaller packages for bids?		Indicated the scope of supply which is all items on the MEL except bow thruster, engine control room console, bridge control console, integrated control and performance monitoring, lube oil transfer pump, and steering gear.	Would be prepared to accept a single PO, but would probably comment regarding items they would be prepared to offer.
VIRL			
3. How could vendors meet information requirements? Where would there be difficulties? What would vendor need to know about the shipyard?	Response is feasible, problems with some areas: • Project Quality Plan - Dates would be questionable. • Project Plan - Date is questionable. • 2 General Documents, 3 Electrical Documents, 4 Instrumentation - Most delivery dates are aggressive. Could be achieved if bid time was reasonable and there was partnering or teaming during bid process. Experience is that bid times are usually absurdly short with lack of direction during bid process. Assume shipyard will provide drawings, specs., etc. at time of bid request.		Generally information in VIRL is provided with delivery of a propulsion system. Some items require formality not typically provided, however it generally falls into the type of data provided.

Questions	Response Engine Vendor A	Response Engine Vendor B	Response Engine Vendor C
4.. How could VIRL be improved?	No suggestions.		Generally looser requirements stating "vendor format acceptable" would improve VIRL.
Vendor/Shipyard Relationship Scenario of vendor/shipyard relationship with a controlled specification such as the VIRL			
5. How could preferred vendor relationship be established?	Pre-selection survey early in program to determine qualified and preferred suppliers for bid process. Shipyard would then enter into a teaming agreement with primary candidate. Vendor sees advantages to team approach. Vendor could assist shipyard during spec. development. Accelerate bid/proposal process and minimize the deviations and clarifications that often occur after contract award.		Vendor works closely with shipyards to assist in project planning and has developed this type of relationship over a period of years.
6. Is this scenario appealing to your organization? What aspects are most important?	Very appealing. Recent programs require extensive product support information during proposal process that formerly was required after award. Competitive environment during bid process diminishes quality and level of cooperation. If preferred vendor relationship established at the onset the requirements would be better understood and objectives would be realized more quickly.		Vendor has worked very closely with shipyards, consultants, and end customers since inception of potential projects to ensure project success.

Questions	Response Engine Vendor A	Response Engine Vendor B	Response Engine Vendor C
Other Comments.		VIRL is a valuable tool for any yard. Content and time frame influenced by: vessel type, delivery date, vendor location, vessel design, delivery date of equipment, and shipyard qualification. The individual scope and time criteria varies based on manufacturer. Common practice for yard to discuss and agree upon such a list with supplier prior to signing a contract. The list then becomes a part of contract.	•

Questions	Response Engine Vendor D	Response Engine Vendor E
MEL for Propulsion Equipment		
1. Would you contract all of MEL as a single suite?	Vendor usually sells through dealers for smaller projects. Feels that ship owners prefer to deal with a single engine room source when it comes to service and warranty questions. Main problem is achieving a realistic appreciation of the value added when the engine supplier does this.	Would provide majority of equipment, but not all. Some items do not make sense for an engine/propulsion equipment supplier. Such as where ship interference's would be complex or cost prohibitive. If there is potential for change or if item is ship specific it makes sense for shipyard to be responsible. Supplier is fully capable of providing all engine auxiliary equipment.
2. Would you bundle into smaller packages for bids?	Suggests bundling and assembly of engine room items into modules to help assembly process. Yard's lift and handling capacities must be considered. Modules would have common purpose, fuel treatment plant, propeller and shafting, gen sets, switch gear. Advantage to yard would be to minimize the number of "erector set" items.	Single purchase orders usually written, however specifications are jointly developed. Supplier provides detailed specification based on yard performance-based spec. This detailed spec. is reviewed with yard. After approval, a final spec. is approved for purchase and manufacture. International shipyard/vendor relationship must be more proactive than in US. "Partnering" is important. US yards and Navy use terms such as IPPD, but have a long way to go before a feeling of TRUST is developed, based on *performance specification.* Scope of supply would include all items in MEL except for bow thruster, galleries on engines, integrated control, uptakes piping, HFO transfer pump, MDO transfer pump, lube oil transfer pump, and steering gear.
VIRL		
3. How could vendors meet information requirements? Where would there be difficulties? What would vendor need to know about the shipyard?	Could provide information for own items within required time. For other items at mercy of supplier.	Information in VIRL is necessary in most cases. Vendor marked up the VIRL. A number of specific areas were questioned that vendor felt would be covered by class approval and ISO standards and vendor Installation Planning Instructions. Also had detailed comments on dates identifying Release for Manufacture as a key reference milestone for final documents.
4. How could VIRL be improved?		VIRL could be improved by remembering organizations are personnel-limited. VIRL is overly specific. Only information that is ABSOLUTELY necessary should be included in request. Navy and commercial US yards should not specify method, but performance. VIRL is littered with requirements to PROVE design and PROVE methods of design and manufacture. Such

Questions	Response Engine Vendor D	Response Engine Vendor E
		requests bog down the process and responsibly shifts to shipyard. This goes contrary to "best commercial practice" and establishing relationship based on trust and supplier accepting warranty.
Vendor/Shipyard Relationship Scenario of vendor/shipyard relationship with a controlled specification such as the VIRL		
5. How could preferred vendor relationship be established?		World competition in Diesel engine market is fierce. The most important and critical aspect of success is the relationship between vendor and customer. A valued vendor provides value to the customer to help him. This includes detailed information (perhaps proprietary) and competitive pricing at design and budget stage. This can eliminate a lot of design work and risk pricing. The educated shipyard decides who he wants to have as partners and develops the relationship in anticipation of working together. Areas of quality, service support, price/value, and life cycle issues must be addressed so builder will be thinking like ship owner. Price competitiveness alone is least important. Vendor helping builder to be more competitive and partnering for the future is most important.
6. Is this scenario appealing to your organization? What aspects are most important?	Design control and purchasing control have to be in the same hands.	This vendor is a leader because they actively strive to develop relationships, as it is important to their customers to continue this relationship based on trust. If price, which is evaluated at a relatively low level, is the decisive factor in vendor selection; then the relationship will fall apart. The relationship must be developed at a high level in both organizations, both companies will strive to be ambitious and successful in the sale of the ship, as well as the equipment.
Other Comments.		

Questions	Response from Air Conditioning and Refrigeration General Vendor A	Response from Electronics, Controls, and Navigation General Vendor B	Response from General Vendor C
MEL for Propulsion Equipment			
1. Would you contract all of MEL as a single suite?	Vendor could respond to equipment only, design only, or complete turnkey package including installation. Would be prepared and interested in contracting as a single purchase order.	Vendor is often prime where they supply own equipment and others. Advantageous when developing interfaces between vendor and subcontractors. Also moves responsibility for the interfaces from shipyard to systems integrator.	Frequently contract to supply bundled equipment, some manufactured by vendor and some purchased from subcontractors.
2. Would you bundle into smaller packages for bids?	NA	Logical partition is for systems that interface with or are similar to vendors equipment.	Varies case by case. Like or related items should be OK.
VIRL			
3. How could vendors meet information requirements? Where would there be difficulties? What would vendor need to know about the shipyard?	Could meet VIRL with date changes as specified in mark-up.	Information requirements can be met at a cost. When shipyard requirements are increased there is an increase in price and schedule is lengthened. Most vendors have standard documentation which can be provided immediately. Limitations in manpower often impose schedule extensions to provide custom data formats.	VIRL is very extensive and costly for vendor to supply. Otherwise, would not have a problem.
4. How could VIRL be improved?	Tabulation is satisfactory.		Simplify the VIRL. Specific comments on VIRL include: • Some of the dates are quite short. • Motor data information may not be available • Noise data sheet will be quite costly.
Vendor/Shipyard Relationship Scenario of vendor/shipyard relationship with a controlled specification such as the VIRL			
5. How could preferred vendor relationship be established?	Vendor interested in closer vendor/shipyard relationship. Could be implemented by meeting and	Preferred vendor would provide most equipment for a given type. Overall lower pricing can be achieved through	Selection of vendor based on capability and working relationship with the shipyard. Successful vendor should be

Questions	Response from Air Conditioning and Refrigeration General Vendor A	Response from Electronics, Controls, and Navigation General Vendor B	Response from General Vendor C
	explaining capabilities, assets, and financial backing. A signed agreement would provide advanced data, information, and pricing with realization that increased sales would be awarded by shipyard.	higher volume. Almost as important is standard documentation eliminating the need for new drawings, manuals, or provisioning. This results in lower costs for vendor and shipyard. Preferred vendor agreements can be negotiated in advance with suitable price breaks based on volume.	permitted to make reasonable profit and not forced into cut throat competition.
6. Is this scenario appealing to organization? What aspects are most important?	Yes.	Yes. It would increase sales volume, reduce manpower requirements and marketing expenses and create a better relationship between vendor and shipyard.	Partnership to advantage of both parties. Shipyard would receive reliable, trouble-free equipment on schedule without hassle at a reasonable price. For vendor the relationship would have to break the bid (or auction) mentality surrounding each buy. Vendor must be allowed to make a reasonable profit, or vendor must lose money (unacceptable to vendor) or short buyer (unacceptable to shipyard).
Other Comments.			

Questions	Response from Marine Joiner Vendor D	Response from Marine Bearing Manufacturer General Vendor E	
MEL for Propulsion Equipment			
1. Would you contract all of MEL as a single suite?	Prepared to bind on MEL for marine interiors and accommodations. Vendor would be interested in contracting for complete interior as a single purchase with eventual selection of subcontractors based on their expertise, experience, and job specific needs. Vendor has such experience.	The vendor would bid only on equipment manufactured in house. To bid on a package and act as prime would mean increasing subcontractor costs to cover cost of administration. It would also result in an increased lead time.	
2. Would you bundle into smaller packages for bids?	Assuming single purchase order would be too expensive. Would consider specific areas and bids consistent with building strategy of the shipyard.	Most favorable bundle would be to include products into groups manufactured by a single company unless there is a previous history of cooperation. Experience has shown that setting up a manufacturing relationship between companies results in delays and cost increases. Ideal grouping for this vendor would be: rudder stock and pintle bearing, stern and strut bearing, line shaft bearing, thrust bearings, and local bearing temperature monitoring systems.	
VIRL			
3. How could vendors meet information requirements? Where would there be difficulties? What would vendor need to know about the shipyard?	Would provide information required. This information would be an outline based on qualifications of work. The VIRL would reflect clear definitions of milestones and scope of work. To improve VIRL, shipyard must develop information that is needed and essential. No value information is as expensive to provide as high value information. Keep end in mind.	It would not be possible to meet VIRL requirements.	
4. How could VIRL be improved?	Vendor would be willing to discuss the approach and benefits with shipyards.	Do not impose arbitrary dates, but set dates actually required by shipyard.	

Questions	Response from Marine Joiner Vendor D	Response from Marine Bearing Manufacturer General Vendor E	
		Shipbuilder must keep vendor involved in ship building schedule and notify about any changes.	
Vendor/Shipyard Relationship Scenario of vendor/shipyard relationship with a controlled specification such as the VIRL			
5. How could preferred vendor relationship be established?		The preferred vendor relationship would be developed from suppliers with a proven track record. Preferred vendor program would work by having shipyard offer to buy components from the vendor at a fair market value before going into bid. This would contribute to eliminate the expense of the bid process.	
6. Is this scenario appealing to organization? What aspects are most important?	Scenario is very appealing. The most important aspect is customer satisfaction.	Yes if directly with shipyard. However, the vendor would find it extremely costly to integrate products into a prime contractors own products.	
Other Comments.			

6. Analysis and Discussion of Results

This section includes a analysis and discussion of the shipyard and vendor results.

6.1 MEL

The shipyard and vendor comments on the MEL showed many similarities and a few differences. The responses have been compiled into the following consolidated list:

1. Shipyards and vendors agree that the MEL is generally too extensive for a single vendor although most would be willing to provide the majority of this equipment.
2. There was some variation in response based on size and power of the propulsion system with smaller systems being more likely to be filled with a few large orders or even a single order
3. The response also varied depending on the engine vendors scope of supply. Some engine vendors were willing to provide entire supply by subcontracting out equipment that they did not manufacture.
4. Major engine vendors could provide most of list including: the main engines and auxiliary support systems, CPP propeller and auxiliary support systems, propulsion reduction gear, clutches, couplings, shafting, bearings, bridge and engine room controls and sensors, most pumps, tools, supervision and advisory work, generator sets, PTO generator sets, and generator auxiliary support systems.
5. Major engine vendors usually would not supply the integrated controls software, uptake piping, bow thruster, steering gear, and transfer pumps. Some areas would not make sense for the engine supplier such as where interferences within the ship would be complex or cost prohibitive for the engine supplier. If there is a potential for change or an installation becomes ship specific then the shipyard should assume the responsibility.
6. Even when the engine vendor provides a single source of supply with a single purchase order separate specifications are usually developed. These specifications are developed jointly. The shipyard provides a performance specification. The supplier then develops a detailed specification. The final specification and design are then jointly developed by the vendor and the shipyard. This process requires a high degree of trust and a close working relationship (see section 6.3).
7. The bundling and assembly of engine room items into modules would help the yard assembly process. This requires a close vendor/shipyard relationship with a large amount of shared information and experience.

6.2 VIRL

The comments on the VIRL differed between shipyards and vendors. Shipyards generally felt that this was a useful document with adequate detail. The vendors were not as comfortable with the level of detail and often expressed the sentiment that the VIRL tended to over-prescribe with little benefit to the shipyard and added cost to the vendor. Specific comments include:

1. VIRL is generally a helpful document for yards to prepare contract specifications. It is expected that the VIRL would be a project-specific document.
2. The format of the VIRL is reasonable with most items being necessary.
3. Engine vendors tended to feel that some items in the VIRL were too specific or formal. They suggested to simplify the VIRL to only include required items. One shipyard noted that the VIRL contained a significant amount of data not needed by the shipyard or owner.
4. Relying on industry standards (class, ISO, etc.) would be less costly.
5. One vendor noted that the VIRL has many requirements forcing the vendor to prove design, prove methods of design, and prove methods of manufacture. He felt this shifted responsibility wholly to the shipyard and was

contrary to “best commercial practice” where the supplier accepts responsibility. In this instance the shipyard and owner will trust the vendor to know and apply the best method.
6. Specifics about dates will vary. Contract dates are often developed without knowing the actual shipyard “need” dates. Designers should be given greater latitude to decide when and what they need. This involves pushing the decision down to the working level. Dates should not be set too early in the process.
7. Vendors noted that all requests for data or to reformat data are costly. Recommendations were made to state “vendor format acceptable” whenever possible.
8. Consider cost and schedule impact of vendor response to VIRL.
9. Limitations on vendor manpower resources can cause schedule slips when responding to custom data requests.
10. Allow vendor to answer requests by using standard equipment documentation.
11. One shipyard requested adding a Milestone Payment Request column to indicate if a item is linked to a payment.

6.3 Shipyard/Vendor Relationship

Perhaps the most significant portion of this survey is the shipyard/vendor relationship. Both vendors and shipyards expressed interest in establishing a preferred vendor relationship. Many shipyards and vendors had already entered into some form of this relationship with vendors entered on a yard Maker’s List.

1. Pre-award identification of preferred vendors who are identified as teaming members with shipyard.
2. Sequence of documentation should include a Functional Specification, Detailed Specification, and Final Manufacturing Specification.
3. Relationship (trust and teaming agreement) is more important than data formats.
4. Shipyards and vendors agreed on the value of pre-qualification of vendors and availability of data during the bidding and design process. There should be a mutual relationship with shared responsibilities.
5. Dates should be set a late in the process as can be reasonably done.
6. The simple existence of an Integrated Process Team does not assure a working relationship based on trust.
7. Vendors and shipyards agreed that price competitiveness alone is one of the least important aspects.
8. Vendor shipyard relationships must be developed at high levels in both organizations with an eye toward the long term or they will fall apart. This allows both parties to be ambitious and successful in the sale of the ship, as well as the equipment. Both vendor and shipyard need to think like owners, who are their eventual customers.
9. Ability of vendor to assist shipyard in leveraging cost, customer service, and cycle time are very important. Also important is the ability to collaborate in design and minimize various types of cost exposure and technical risk. These are significant market differentiators.

6.4 Other Comments

The following is a compilation of other comments received during the survey.

1. One shipyard noted that the problem is not the lack of data, but the lack of understanding of the details required by the shipyard (both inside and outside) and the vendor.
2. What processes do “world class” shipyards use?

APPENDIX E

Report on a Survey of European Shipyards and Vendors, Vendor Furnished Information (VFI) Development Guidelines, 12/14/98.

Report on a Survey of European Shipyards and Vendors

Vendor Furnished Information (VFI) Development Guidelines

Contract Number N00014-94-2-0011
Avondale Purchase Order Number MB00888

NSRP Project No. 6-96-2

NSRP Panel SP-6

Prepared for:
William G. Becker
NSRP Program Manager for
Panel SP-6 Marine Industry Standards

Submitted by:
Avondale Industries, Inc.
P.O. Box 50280, Mail Stop 98
New Orleans, LA 780150-0280

December 14, 1998

Table of Contents

INTRODUCTION

Background

In February, 1997 the National Shipbuilding Research Program (NSRP) Panel SP-6 tasked Avondale Industries Inc. to develop guidelines for the timely and accurate transfer of information between vendors and shipyards during the ship acquisition process. M. Rosenblatt & Son, Inc. and Harland and Wolff were tasked as subcontractors to Avondale Industries in this project. The goal of this work is to reduce the time for the design, acquisition, construction, and repair process in the U.S. shipbuilding industry.

One objective of this work was the development of documentation to enhance and streamline communications between shipyards and vendors. This effort included the development of a strawman Master Equipment List (MEL) for Propulsion Machinery and a Vendor Information Requirements List (VIRL). The MEL included all of the propulsion machinery and electrical service equipment for a typical 15,000 DWT tank ship. The VIRL was a notional template for specifying the delivery of vendor information. Copies of these documents were sent to several U.S. Shipyards, domestic equipment vendors, and foreign equipment vendors. These companies were asked to assess these documents by responding to a list of questions. Responses were compiled and presented in a report in May 1998 from three shipyards, four marine engine vendors, and five general marine vendors.

Perhaps the most significant portion of this survey was the discussion of the shipyard/vendor relationship by the participants. Both vendors and shipyards expressed interest in establishing preferred vendor relationships. Many shipyards and vendors had already entered into some form of this relationship with vendors entered on a yard maker's list. The survey responses noted many aspects of this relationship including:

- The pre-award identification of preferred vendors who were considered teaming members with the shipyard.
- It was also noted that the relationship (trust and teaming agreements) was more important than data formats.
- Shipyards and vendors agreed on the value of pre-qualification of vendors and the availability of data during the bidding and design process. This should be a mutual relationship with shared responsibilities.
- Vendors and shipyards agreed that price competitiveness alone is one of the least important aspects of the relationship.
- Vendor-shipyard relationships must be developed at the working technical level and at the senior management level in both organizations with an eye toward the long term or the relationships will not succeed. These relationships should allow both parties to be ambitious and successful in the sale of the ship as well as equipment sales. Both vendors and shipyards need to think like owners, who are their mutual customers.
- Ability of the vendor to assist the shipyard in leveraging cost, customer service, and cycle times are very important. Also important is the ability to collaborate in design and to minimize cost exposure and technical risk.

Objective

Based on the survey results, an investigation was initiated to develop a more detailed understanding of the relationship between vendors and shipbuilders in the international market. The investigation was undertaken by conducting interviews with a major Italian shipbuilder, a small Italian shipbuilder, and a number of shipbuilding vendors. The subjects covered included the development, maintenance, and significant elements of the working relationship between vendor and shipbuilder.

The survey was conducted by holding a number of interviews from 27 October through 30 October, 1998. These interviews were arranged with the assistance of International Marketing & Business, Inc. located in Washington, D.C. The surveyed companies are shown in the following table.

Italian Shipyards and Vendors Surveyed

Date	Location	Subject of Interview
27 October	Trieste, Italy	Fincantieri – Cantieri Navali Italiani SpA (World class ship builder. Specialties include cruise ships, large monohull ferries, Ro-Ro vessels, and LNG ships.)
		Wartsila NSD, Grandi Motori Trieste SpA, (Diesel engine manufacturer.)
28 October	Monfalcone, Italy	Navalimpianti Group SpA (Vendor for cargo doors, ladders, liquid cargo handling systems, and boat davits.)
	Venice, Italy	MANA Costruzioni e Manutenzioni Navali, Srl (Small shipyard and subcontractor for Hopeman Brothers. This organization is also a subcontractor building outfitting systems for the public spaces on the Disney cruise ships.)
29 October	Vicenza, Italy	SADI SpA (Marine manufacturer cabin interiors and public spaces including false ceilings and sign systems.)
	Verona, Italy	Marine Equipment Pellegrini, Srl (Manufacturer of deck machinery, davits, cranes, hoists, and anchor handling gear.)
	Verona, Italy	Officina Forcato (Manufacturer of marine interior lights and navigation lights.)
30 October	Acqui Terme, Italy	Pompe Garbarino, SpA (Manufacturer of all types of marine pumps.)

TECHNICAL APPROACH

Prior to conducting the surveys, each participant was sent a brief explanation of the purpose of the visit and the questions which would be covered. This included the following questions about the nature and extent of the shipyard/vendor relationship.

- How is relationship with vendor developed and maintained?
- How does the shipyard view the vendor as a business partner? Is this a short or long term relationship? How is the relationship developed and nurtured?
- What are the goals of the respective partners? Does the vendor undertake a greater role with increased responsibilities, risk, and rewards? How does the vendor assist shipyard in leveraging cost containment, customer service, and cycle time reduction?
- Communication: How do the parties assure clear and complete communication in all aspects of the business relationship (marketing, proposals, planning, design, production, trials, and guarantee)?

The area of interest included all aspects of the vendor/shipyard relationship including technical data and drawings, although specific information on computer systems and CAD data was not the focus of this effort. Technical Data could be in any form: paper report, computer database, CAD drawing, or 3D product model (including geometry and other attributes such as material, weight, identification, and specifications). Technical data includes any of the following:

- Quality Assurance and Quality Control: ISO 9000 compliance and other requirements.
- General Data: layout, foundations, data sheets, utilities requirements, design calculations, installation, operation & maintenance manual, spares, special tools, shipping/handling/storage instructions, preservation & maintenance, surface preparation & paint, test, bolt schedule, foundation loads, mechanical seals, and heat emission.
- Electrical Data: layout, wiring diagrams, power & lighting cable schedule, protective devices operating curves, construction drawings, and performance data.
- Instrumentation Data: logic cause & effect diagram, software system, instrument legend, hook-up diagram, layouts, control panel, mounting equipment details, instrument schedule, instrument location, instrument specification, housing and winterizing, and cable layout.
- Certification data: materials, type tests, hazardous area classification, ingress protection, conformity, fire safe, material location plan, welding procedures, NDT procedures and records, dimensional control, furnace charts, pressure tests, factory function and acceptance test, speed/torque curves, short circuit & motor test certificate, cable continuity and resistance, dynamic balance report, proof load certificate, calibration, and certified markings

Questions were also asked about the integration of technical data into the shipyard/vendor data stream. This integration included the areas:

- How does the shipyard integrate the vendor equipment into technical data including computer databases, 3D definitions, and drawings? Do the parties use common systems or do they develop and use interface specifications (IGES, STEP, etc.)? What role does electronic data transfer play?
- How is vendor data integrated into the pre-production and marketing process?
- How is vendor data integrated into the planning process and ordering process?
- How is vendor data integrated into engineering design process? What is the scope of vendor involvement? How does this affect the modular design?
- How is vendor data integrated into the production process? What is the scope of vendor involvement? Do vendor personnel install equipment?
- Specifications and Standards:
    - What specifications are developed and who is responsible for their development?
    - What is their content?
    - How are they maintained and revised?
    - Does the shipyard develop a performance specification and vendor develop a detailed specification?

Typically the interviews lasted 2 to 3 hours. The surveyor would begin each interview with an explanation of the scope and purpose of the sessions. After this introduction, the discussions were allowed to range fairly freely. This format was selected because it allowed the vendor and shipyard personnel to focus on the areas that they felt were the most significant.

SUMMARY OF RESULTS

During the interviews it was found that there was a surprising degree of consensus within the organizations and individuals that were included in this study. A number of significant points were raised repeatedly. They are summarized below:

1. The influence of vendors and impact of vendor costs are enormous factors in modern shipbuilding. Vendor costs account for 60% to 75% of total shipbuilding costs for large cruise ships. The success of large and complex ship building programs relies upon a strong network of skilled vendors.
2. European shipbuilders have developed a network of preferred vendors with whom a formal business relationship is established. Preferred vendors are not guaranteed business, but are shown a preference. The relationship between shipyard and vendor is different depending on the scope of supply. Major vendors represent the largest amount of business, are critical to the success of the program, and impact major milestones in the production schedule. These include propulsion systems, entertainment systems, steel, public areas, galleys, accommodations, fire fighting systems, cargo systems, and bridge and navigation systems. The shipyard develops and maintains a complex and diversified network of vendors and material suppliers who have a strategic impact on shipbuilding programs. These vendors have global marketing perspectives and are continuously monitoring and applying innovations in technology. They propose new opportunities from the market and create confidence in the sources of supply.
3. There has been a significant increase in turnkey contractors in the last 10 years. These turnkey contractors provide all aspects of some portion of the ship or ship systems. The turnkey vendor-shipyard relationship is difficult to develop and maintain, but the rewards are significant. Turnkey vendors must be highly skilled and there is a risk that using them can increase costs if the process is not carefully managed. However the careful use of turnkey vendors reduces shipyard construction costs and shortens delivery schedules.
4. Each shipyard is faced with a unique situation considering a number of diverse factors including specialization, local business practices and regulations, physical restraints including storage capacity, shipping, crane capacity, size of the organization, access to vendors, and other factors. This unique combination of factors dictates an equally unique business strategy and vendor relationship. There are no stock answers. Likewise, owners also have individual preferences based on their business goals. The vendor must anticipate all of these preferences.
5. Some shipyards are meeting the challenge of optimizing purchasing through the development of pooling organizations, such as the EuroShip group. This organization is comprised of four shipyards: Fincantieri (Italy), Howaldtswerke Deutsche Werf (Germany), Chantiers de l'Atlantique (France), and Astilleros Espanoles S.A.(Spain). EuroShip provides a forum for member shipyards to exchange data. They have developed standards for common vendor items and have also developed purchasing agreements with vendors. Through one to two year agreements, high volume suppliers and standardized material vendors agree to provide their standard items at a guaranteed cost. The vendor benefits from increased volume and the shipyards

benefit by a lower cost. This organization also provides a forum for sharing knowledge of the vendor market.

6. The technical personnel from shipyards and vendors must have a strong relationship. For instance, the supplier often gives suggestions in order to make a system less expensive or more functional. The shipyard designers often ask the suppliers to help solve problems before the supplier is involved in the project.
7. Lead-time is a major factor as ship delivery schedules are compressed. This is especially important with all long lead-time items. The goal is to get the vendor involved as early as possible in a manner consistent with the lowest cost, acceptable quality, and schedule requirements of the shipyard. The present system is still struggling with this issue as the shipyard purchasing process sometimes loses valuable time during the bid process. This is a major area of study for both vendor and shipyards.
8. Larger shipyards tend to be more bureaucratic, smaller yards have simpler structure with the same person having both technical and purchasing authority. The bureaucratic delays and inherent isolation of the larger shipyards result in a longer time for inquiry. Therefore there is a shorter time for the vendor to respond once the order is made. Vendors are often forced to begin a project prior to receipt of a formal order.
9. Both vendors and shipyards desire to develop a partnering relationship that will allow greater integration of the vendor products into the design. This would result in the vendor being more involved in the project in the pre-award phase thereby reducing communication lags. This growing trend has not reached maturity and the exact method of implementation remains unclear.

CONCLUSIONS

The European shipbuilding industry is strong and diverse. It has been successful in the world market when producing high value ships such as cruise ships, Ro-Ro ships, LNG carriers, parcel tankers, chemical tankers, and high speed ferries. This success has continued during a time when the shipyard workforce has shrunk as the majority of the costs have been shifted to vendor supply. This transition has required developing and maintaining long term relationships between vendors and shipyards that transcend the traditional purchase order driven environment.

The vendor labor hours accounts for a major portion of the labor hours required for ship construction. In a large cruise ship approximately 50% of the laborers working onboard the ship during outfitting are subcontractors. This very large percentage of vendor laborers requires the vendor to be very knowledgeable of and skilled in the application of shipyard procedures.

The use of information technology and CAD/CAM/CIM systems are essential for delivering complex ships in the global market. However, the effectiveness of this high technology is limited unless the shipyard-vendor relationship is highly developed and carefully maintained. Vendor relationships differ for small shipyards versus large shipyards. The larger shipyards are more bureaucratic, communication more difficult, and there are longer delays. Smaller shipyards can respond more quickly. Vendor relationship with shipyards are largely molded by the vendor scope of supply. Vendors that supply material and stock components do not require the close integration that is necessary for vendors that supply complex systems and subsystems.

There are no pat answers, the situation varies from locale to locale and is continuing to change over time. The general trend is for vendors to provide more services on a turnkey basis. Vendors are continuing to expand their scope of supply to include more engineering and design services in addition to their basic hardware offerings. Shipyards are looking more to vendors to supply these services and bring their expertise and knowledge of new technological developments during the pre-contract phase of a project. Engine manufacturers are offering turnkey services for total design, build, and installation of all equipment in machinery spaces. The outfitting contractors are offering similar services for complete design, building, and installation of all outfitting in areas of the ship. These major subcontractors will utilize the services of a large number of third-tier subcontractors.

Vendors and shipyards are beginning to think more in terms of lifecycle support and of the ultimate customer, the ship owner. Finally vendors and shipyards are exploring ways to develop partnerships that would result in even closer links between their organizations.

In this dynamic shipyard/vendor relationship there are no stock solutions. The principal factor is how the respective organizations see meeting their individual goals by utilizing their respective strengths. The idea of partnering is growing, but a clear means of implementation has not emerged. This is clearly an area where United States shipbuilders must carefully monitor the changing market place and adapt their business strategies.

Appendix A-Fincantieri Cantieri Navali Italiani - Shipbuilder

Vendor Furnished Information Interview Report

Date: 10/27/98
Company: Fincantieri Cantieri Navali Italiani, SPA
Location: Merchant Shipbuilding Division Headquarters, Trieste, Italy
Personnel: Mr. Guerrino Saina, Executive Director of Purchasing Department

Business Summary:

Fincantieri is the largest shipbuilding organization in Italy and a major world class ship construction firm. The company is divided into two divisions: merchant shipbuilding and naval shipbuilding. The merchant shipbuilding division headquarters is in Trieste. This division is comprised of five shipyards located in Ancona, Castellammare di Stabia, Marghera, Monfalcone, and Palermo. The naval shipbuilding division headquarters is in Genova. This division is comprised of two shipyards located in Muggiano and Riva Trigoso. At these shipyards there has been a major transition in the shipbuilding process, especially in the commercial division. The core of the transitions is a major increase in the use of "turnkey" vendors and the simultaneous reduction of in-house workers. In 1987 there were 23,000 shipyard working with a production output of 1.2 billion US dollars. In 1997 the number of workers had fallen to 9,500 even while the value of production increased to 2.25 billion US dollars.

Fincantieri has developed a niche market producing specialty ships that have very high value and that are extremely complex. These include cruise ships, the largest monohull high-speed ferries in the world, LNG carriers, and various Ro-Ro vessels. The cruise ship business constitutes 51% of the commercial business including:

- the world's fastest cruise ship, the "Rotterdam" (25 knots)
- the world's largest cruise ship, the "Grand Princess" (109,000 gross tons), and
- the world's longest cruise ship, the "Disney Magic" (294 m).

A summary of the cruise ships constructed and on order is given in the following table. Fincantieri has a 37% share of the world cruise ship market making them the number one builder in the world.

Summary of Fincantieri Cruise Ships Built or on Order, 1990-2001

Owner	Number of Ships in Class	Length Over All (Meters)	Gross Tonnage
P&O Lines	2 ships	245.0	70,000
	4 ships	261.0	77,000
	4 ships	261.0	77,000
	3 ships	290.0	109,000
Costa Crociere Lines	2 ships	219.0	53,000
	2 ships	219.0	53,000
Holland America Lines	4 ships	219.3	55,000
	2 ships	237.0	60,000
Carnival Lines	5 ships	272.0	102,000
Disney Cruise Line	2 ships	294.0	85,000

Business Practices

The focus of this investigation was on cruise ship construction as this represents the largest and most complex ships. The majority of the value of the construction of commercial ships is found in material and subcontractor support. The cost break-down is 70-75% external costs (vendors) for cruise ships versus about 60% for cargo ships. The number of major vendors in a cruise ship is double the number required for cargo ships. The material costs on passenger ships are five to six times the costs of cargo ships. The contracted furnishings of the passenger ships represent about one quarter of the total costs and the contracted systems another quarter. This significant reliance on vendors has resulted in a system of selecting preferred vendors. The vendors, in turn, will utilize a number of subcontractors which represent about 17% of the total manpower in the ship construction program.

The success of building large passenger ships is based on the relationship between the shipbuilder and the suppliers. This is evidenced by the recent construction of a cruise ship in Japan where the shipyard utilized all European suppliers. Fincantieri buys $200 million to $1 billion of components per year. This purchasing is done out of the Trieste headquarters for all 5 commercial shipyards. There are 80 people in Trieste and a similar number distributed at the shipyards.

In order to develop a closer relationship with suppliers and to assure the lowest cost, a system has been developed to create a list of preferred vendors. These vendors are qualified as A, B, or C class suppliers.

The A vendors are the ones most important to the success of the shipbuilding program. They represent the largest amount of business, are critical for the success of the program, and represent major milestones in the production schedule. These A vendors include the propulsion system, entertainment system, steel, public areas, galleys, accommodations, fire fighting systems, cargo systems for cargo ships, bridge, and navigation systems. There are 100 to 200 major vendors for the large passenger ships. The relationship between shipyard and major vendors is continuing to develop. Often the suppliers open a local office to better facilitate communication.

There is not a very significant difference between the B and C vendors. While these vendors do not have an impact on major milestones in the production schedule, they are still important to the overall success of the project. For these vendors there are no specific major schedule requirements and the shipyard does not monitor technical design. The B vendors include general catalog suppliers and material suppliers. The C vendors represent the remainder of the material and stock item suppliers. Again the shipyard does not exercise control over the material production process. These represent the minor materials.

The purchasing division applies a number of principles in their business plans. This includes developing and maintaining a complex and diversified network of vendors and

material suppliers. It is acknowledged that the vendors have a strategic impact on shipbuilding programs. Their marketing perspectives are global include continuous monitoring and application of innovations in technology. The responsibilities of the purchasing division includes a guarantee of economy. They bring within the company knowledge of the market. They propose new opportunities from the market and create confidence in the sources of supplies.

In the last ten years there has been a significant increase in the use of "turnkey" contractors. Turnkey contractors supply all aspects of some portion of the ship or ship systems. It is very difficult to develop and maintain these relationships. For instance, the turnkey contractor must be highly skilled. In addition, there is a risk factor undertaken by the turnkey vendor which can increase cost if not carefully managed. Sometimes it is difficult to assure enough competition among turnkey vendors, which can make the cost higher. Finally it is possible to lose control (of schedule or technical information) of turnkey vendors. However, even with these pitfalls, the turnkey solution can be successfully applied in many areas because the alternative is to purchase, design, and develop everything in house. The in-house method tends to minimize material purchase costs, but not necessarily to minimize the total construction costs. There can be problems in coordination and delays that result from attempting to do all work in house. The shipyard must develop their plans while carefully balancing the pros and cons of turnkey contracting.

In Europe, the present situation is to use some turnkey contractors. Each yard has a different situation with unique requirements and a customized solution. For instance in Italy, it is very difficult to layoff workers and it is difficult to hire contract labor. For these reasons the shipyards will make use of subcontractors who are responsible to provide various physical components. This work may be performed at a separate site or within the shipyard. Other local factors may include the storage space at the shipyard. Many yards are located in tight quarters where storage space is at a premium. Therefore it is very critical to their business that material and large assemblies arrive exactly on schedule. Early deliveries can cause a problem as much as late deliveries.

Because of the many variables and changing situations, there are no specific rules. The standard business practice is for the yard to focus on their core business which they manage directly. Other aspects of the work can be outsourced. It is necessary to continuously consider the make versus buy decision as the specific situation changes with time. While there is a tendency to increase outsourcing, the optimal solution might not necessarily be the one with maximum outsourcing. As a rule, it is common for smaller shipyards to outsource more work. This is because they are subject to wider fluctuations in work load. More subcontracting allows them to expand and contract quickly. It also allows them to shift their business focus quickly based on market requirements.

One solution to optimize the purchasing is through the development of purchasing or pooling organizations. The EuroShip (European Share International Purchasing) organization is one such group. This organization is comprised of four shipyards: Fincantieri (Italy), Howaldtswerke Deutsche Werf (Germany), Chantiers de l'Atlantique

(France), and Astilleros Espanoles S.A.(Spain). Together they represent a large percentage of European shipbuilders with a combined order book of about 50 ships. EuroShip develops medium term, one to two year, agreements with high volume equipment and material vendors. The approved EuroShip vendors have agreed to provide their standard items at a guaranteed cost to EuroShip members. The vendor benefits from the potential increased volume of sales. By joining forces the group can increase vendor volume with the resulting cost advantage. This group also provides a better knowledge of the market. This provides better choice levers from the shipyard point of view.

EuroShip also provides a forum for the member shipyards to exchange data. They meet once a month and sometimes invite vendors to their meetings. Another service of this group has been the development of standards for common vendor items. For example there is a tremendous amount of electrical cables on a large cruise ship. Therefore any reduction in weight or cost of cables would be significant. The Euroship group performed technical studies on electrical cable supply. Marine cable specifications were found to be unique to each country. EuroShip was able to develop a new specification taking the best from the national standards. In this way they were able to reduce the section weight and area by 50%. A technical specification was developed for the installation and use of the new cables. The new cables have received type approval from various European classification societies and are now manufactured by three major European vendors. In this project the shipyards set the target and the vendors took a very active role in developing the new specification and producing the new product.

Fincantieri has a desire to consider the supplier to be a part of the company. However, the vendor relationship is not formalized. The objective is for the vendor and shipyard to cooperate, not fight. There is the necessity to integrate the vendor products into the design. The people in the respective organizations know each other. Therefore the shipyard and vendor have mutual knowledge which can be used to help each other. For instance, the supplier often gives suggestions in order to make an system less expensive or more functional. The shipyard designers are often asking the supplier to help solve problems even if the supplier is not yet involved in the project.

Fincantieri uses the Intergraph CAD system. The suppliers have their data on their own CAD systems. Most important suppliers will use the Intergraph system in order to ensure compatibility. Smaller suppliers will use the AutoCAD format. There is some specification of the CAD format. All data is in 3-D.

For catalog vendors a very long term relationship is sought. This could last 10 to 20 years. This kind of vendor is looked on as a partner. For these standard catalog items there will be one bid and one negotiation on price that will extend through several ship design projects. These vendors include steel and other materials and standard items such as heat exchangers. Sometimes the agreements are exclusive, sometimes they are not. In either case the shipyard continues to check the market to assure the best price has been achieved. Scheduling is driven by the technical definition of the ships. It is necessary to have the catalog data items in the shipyard design standards.

Outfitting vendors are brought into the project before the contract with the owner is signed. These include the cargo systems, outfitting and furnishings, and the propulsion engines. The shipyard keeps a database of the accommodations costs so it is not necessary to have supplier information from these vendors in the pre-contract stage.

Appendix B Wartsila, NSD - Grandi Motori Trieste - Diesel Engines

Vendor Furnished Information Interview Report

Date: 10/27/98
Company: Wartsila, NSD - Grandi Motori Trieste, S.p.A.
Location: Trieste, Italy
Organization Type: Marine diesel engines and propulsion units
Personnel: Mr. Johan Stoor, Chief Operating Officer
Mr. Giampaolo Cavicchi, Executive Purchasing Department

Business Summary:

Grandi Motori Trieste is a large marine diesel manufacture which builds Wartsila, New Sultzer Diesel, and GMT engines under license. The ownership and composition of the engine manufacture is actually rather complex. A new corporation has been formed from the Metra Group's Wartsila Diesel, New Sulzer Diesel, Diesel Ricerche (a research and development company) and Fincantieri's Grandi Motori. In this new corporation Fincantieri is a minority shareholder.

The Fincantieri shipyards are a major customer for which the factory builds engines with a combined output of 500 megawatts per year. The factory is capable of manufacturing the complete line of medium speed Wartsila engines and the large low speed Sulzer engines. The manufacturing output includes the marine diesel engines and electrical power plants comprised of a diesel engine coupled with a generator. The generators are purchased from the electrical manufacturer and coupled with the diesel engines in a single foundation.

The product line also includes the Propac system which comprises an integrated propulsion system including controllable pitch propellers, reduction gears, propulsion control systems, and prime movers. Other services provided by the manufacturer include basic service agreements and maintenance.

Business Practices:

The marine engine business has felt the need to be more responsive to the needs of their customers. This includes the need to reduce lead time, with currently the lead time per ship being about one year. Another response to the industry is the introduction of pre-designed propulsion packages including controllable pitch propellers, shafting, reduction gear, prime movers, and control systems.

The extent of supply varies with shipyards. Fincantieri prefers to buy components and to design the engine room in-house. Grandi Motori has offered to design the entire engine room, but so far without success with Fincantieri.. For other shipyards the extent of design is greater, sometimes involving the design of the engine room and the associated equipment. For the Visentini shipyard Grandi Motori does the entire engine room design including shafting.

The company produces modules for lube oil systems including filters and pumps for cruise ships. These are turnkey contracts including design, installation, and startup. In addition, Grandi Motori will design the interface for engine control consoles and perform the system tests. In the past the shipyard would decide all of the small details, but this is not the case anymore. Grandi Motori will often be involved in the engine room layout and the machinery foundation design. They will work very closely with the naval architect and can develop the double bottom structural drawings when called up to do so.

Other areas of involvement include the analysis of the propeller wake field and propeller design including blade sections to minimize noise and vibration and maximize efficiency. They will look at the space and weight parameters. They will often visit the naval architectural design companies to demonstrate the advantages of their various designs. They have a full range of powerplants and therefore can be involved in evaluating the impact of the number and configurations of engines. This is particularly true for diesel electric propulsion as this is being installed in the more recent cruise ships. Grandi Motori customers include the shipyard, owner, and naval architect. The owner often has a preferred equipment list which gets the engine vendor involved in the project at an early stage. The engine builder is usually involved before the shipyard makes the offer to the owner.

The engine manufacture is often involved in the development of new products and technologies. One major new innovation is the Azipod propulsor. This azimuthing thruster is comprised of a electric motor oriented on a horizontal axis in a pod that rotates 360 degrees about a vertical axis. The system is very compact and replaces conventional shafting and rudders. This system offers the naval architect considerable freedom in the ability to arrange the ship. Recently ABB, Kvaerner Masa-Yards, and Fincantieri formed a new company, ABB Azipod Oy, to manage the business arising from this electrical podded propulsion system. ABB will be the majority share holder with Fincantieri and Kvaerner Masa-Yards as equal minority share holders. Fincantieri will utilize the Azipod system in future cruise ships. Other new technological developments include low emission systems (especially for large low speed two stroke diesel engines), compact size, lower RPM, diesel-electric power plants, and maintenance systems.

At the beginning of new projects the engine manufacturer will involved in looking at various configurations. The shipyard often has alternative engine suppliers in the pre-order phase. There are usually two vendors during the proposal phase. The shipyard is therefore able to assure a competitive price quotation. The specifications included in the shipyard bid to the owner are open-ended merely stating engine type, speed, and power. For a typical ship the engines may be 7 to 10 percent of the total ship cost. For this reason the shipyard will usually ask two vendors for their bids. An alternative is for the engine to be provided by the owner. This removes the engine cost from the shipyard bid.

One of the most important elements in the marine business is communications. It is often necessary to convince the shipyard to be open with communications between the engine manufacture, the naval architect, and the owner. The engine supplier must be fully

advised on aspects of the design space, weight, RPM, and services. This is not necessarily an issue in series ships where very little engineering is required. This especially true for small and medium size cargo ships where the shipyard may be strongly inclined to use the same engines and the same engine room designs.

While not specifically discussed in this interview, Wartsila NSD is also developing different maintenance contracts with ship owners that include comprehensive packages with performance guarantees in addition to basic spare parts. The goal is for the engine manufacture to be the single source of supply with total responsibility. This has included guarantees including availability, reliability, and efficiency of the shipboard equipment. These long-term agreements utilize in-service support and maintenance by Wartsila NSD engineers. Other engine manufactures such as MAN B&W and MTU Friedrichshafen are also developing enhanced services for the manufacture and installation of spare parts and a world-wide presence. Engine manufactures are clearly focusing on the service-life sales and the enhanced quality that the manufacture can provide.

Appendix C - Navalimpianti Group Boat Davits, Doors, Elevators, Ramps, and Remote Controlled Valves

Vendor Furnished Information Interview Report

Date: 10/28/98
Company: Navalimpianti Group, S.p.A.
Location: Monfalcone, Italy
Organization Type: Manufacturer of boat davits, doors, elevators, ramps, and remote controlled valves
Personnel: Mr. Angelo Misson, Project Manager
Mr. Roberto Bardini, Project Manager

Business Summary:

The Navalimpianti group provides piping systems and outfitting components for cruise ships and bulk carriers. Their scope of supply includes ship-board systems and components including the following:

- Control systems for cargo, ballast, bilge, and fuel oil valves for all ship types. This includes the modular data -acquisition and control system called Proteus. This system is comprised of self-contained valve control modules that are connected to the control console by only electrical power and control cables.
- Ramps
- Watertight doors, ramp, and hull side doors
- Elevators
- Hatchcovers and customized covers for cruise ships
- Boat davits and freefall davits

Navalimpianti provides systems, components, and engineering for a number of shipyards in Europe and throughout the world. Products include the design, fabrication, and installation of doors, ramps, davits, and special covers for cruise ships for various shipyards and liner owners as shown in the following table.

Scope of Cruise Ship Equipment Supply during the Last Five Years

Shipyard	Owner	Number of Ships
Fincantieri CNI S.P.A, Italy	P&O Lines	5 Ships
	Holland American Line	6 Ships
	Carnival Cruise Line	3 Ships
	Disney Cruise Line	2 Ships
Meyer Werft ,Germany	P&O Cruise Line	2 Ships
	Celebrity Cruise Line	3 Ships
	Star Cruise Line	2 Ships
Chantiers De L'Atlantique, France	Renaissance Cruise Line	4 Ships
Kvaerner Masa Yard, Turku New Shipyard	Crystal Cruise Line	1 Ship

The various offices specialize in various types of equipment. The Genoa office specializes in electronics and electrical equipment. The Monfalcone office specializes in deck systems, RoRo ramps, doors, and general ramps. The Polarmo office specializes in davits and winches.

Business Practices

Work is undertaken at three levels of support:

1. Engineering only. Which includes electrical, electronic, automation, sensors, digital control, and structural design.
2. Normal delivery. Which includes all fittings, parts, and steel work manufactured and delivered to the shipyard for installation. It also includes all documentation, manuals, and often includes installation of the equipment at the shipyard.
3. Turnkey delivery. Which includes the engineering, drawings, integration with the overall design, manufacturing and acquisition of all fittings, parts, and steel work, delivery to the shipyard, and installation at the shipyard.

Different levels of support are provided based on the project and the customers preferences. Shipyards usually have a preferred method of working. They have different procedures and methods of operating. This is also true of the owners. Navalimpianti has developed a detailed knowledge of their customer needs through many years of service and therefore are in a good position to anticipate needs even before they are articulated. For instance the cruise ships from Fincantieri tend to have one boat with a single service platform and winch. The Meyer Werft cruise ships usually have two boats and two service platforms and winches. Another example is found in the side doors on cruise ships. There may be 32 to 34 side doors for a typical design. The Fincantieri and Meyer Werft shipyard will require the electronic units to serve 2 to 6 doors. The Chantiers De L'Atlantique shipyard will have dedicated electronic units installed on each door. Kvaerner Masa Yards will order the electronic unit from another company entirely. The typical order from this shipyard will include engineering and supervision for installation.

Recent orders with Fincantieri on the cruise ships are usually turnkey projects. By contrast projects with Meyer & Werft have been normal delivery with all fittings, parts, and steelwork plus documentation. Large shipyards such as Fincantieri have formalized bureaucratic processes that result in a longer time required for the inquiry. The result is shorter time for vendor response once the order is made. This means it is often necessary for the vendor to begin to fill the order official order and receipt of formal data package. Often the vendor will begin working on structural solutions and begin the preliminary arrangements prior to receipt of official order. This close working relationship requires the vendor personnel to develop personal relationships with their counterparts at the shipyard.

Some of the most complex orders are for davits and lifeboats. After the initial inquiry there will be an exchange of drawings between vendor and shipyard. During this period the vendor will rely on his knowledge of the shipyard and owner preferences to develop a preliminary design solution. Often the vendor will suggest changes that will result in

better integration and lower costs. The format of the data exchange includes telephone messages, FAX transmissions, and CAD files sent via email. The drawings developed include details of structural configuration and equipment from other vendors. This information is supplied by the yard. This preliminary stage is conducted at the vendor's expense prior to receipt of the order.

The shipyard engineering department will incorporate the vendor suggestions into the preliminary design. Based on the preliminary design, several vendors will be requested to make a bid. The shipyard will select the final vendor based on price and delivery schedule. The selected vendor will receive the final general arrangements and structural drawings from the shipyard. Unnecessary data will be removed to develop the vendor/shipyard drawings. These drawings will have both a vendor title block and a yard title block. The vendor drawings will be submitted to the shipyard in DXF format. The shipyards have their own specifications for CAD file format and content. The provided drawings will follow these specifications except for the layering conventions. These will often be modified by the vendor because plotter line styles and colors are a function of layering conventions established in the vendors engineering group. These conventions tend to be organization specific and differ between shipyards and the vendor.

Fincantieri has 200 to 300 people in their technical office dedicated to drawing development. These include the structural, outfitting, mechanical, and piping groups. All of their drawings are developed in CAD using the Intergraph system. It is necessary for them to have their own layer naming conventions for line colors and styles. For instance one color is used for all preliminary work. Data transferred from the shipyard to the vendor and back to the shipyard must be incorporated into the final shipyard drawings. The drawing entities in the vendor drawings come from many sources. The shipyard does not require strict adherence to the shipyard standard for these vendor drawings.

The vendor will often work directly with the architect, particularly when developing large unique items that have a significant impact on the ship appearance. These items include the telescoping or sliding skydome covers over swimming pools. The architect will send a preliminary rendering of the skydome cover to the vendor who will develop a detailed design and sometimes a rendering. Transportation of these large skydomes is a very important consideration as the components are large and difficult to move. Thus the size, shape, and weight of skydome components must be carefully considered. The vendor will also conduct a Finite Element Analysis (FEA) of the skydome structural elements. An in-house branch of Navalimpianti performs this analysis. The analysis includes loads, deformations, and stresses. The analysis is submitted to classification societies such as DNV, Lloyds Register, or RINA, the Italian classification society. The vendor personnel know the owner, shipyard, and classification society personnel. This personal contact is critical because time is very short. Notice of approval is usually received first by phone. The vendor will then begin to fabricate the unit. The stamped drawings will often arrive one month later, the appropriate data will be entered, and the certificate delivered to the shipyard.

Personal contacts and company reputation are very important. The delivery schedule is almost as important as the cost. Meyer Werft will typically finish a ship every eight months. This shipyard has very limited dock space. Work must be delivered exactly on schedule. A one week variance either early or late can cause a very big problem because of the very limited space in the shipyard. Because of these other considerations, the selected vendor is not necessarily the lowest cost vendor. The delivered product must be 99% perfect to avoid delays in installation. When a problem arises the vendor people must be available to make adjustments and repairs. They must be flexible as well. It is very important to know the important project milestones. For instance the delivery of davits is critical because they must installed at the proper time. If necessary the davits can be delivered incomplete with outfitting such as wire ropes and controls made later.

Repeat orders can be 90% similar to previous orders. Therefore the previous order data can be used to place orders for long lead items. All of the systems quoted by Navalimpianti are customized. Fincantieri will usually place an order for one or two ships at a time. There may be six ships in a series. The shipyard will usually ask a 10% to 20% discount on follow-up ships.

Small items supplied by this vendor are priced in a catalog. This would include their line of valve actuators. The quantity of these small items will vary by about 10% as the design is finalized. The shipyard will use their historical statistical data to estimate the price of these items, small variations do not matter to the shipyard.

Appendix D MANA - Small shipyard and Outfitting Vendor

Vendor Furnished Information Interview Report

Date:	10/28/98
Company:	MANA Costruzioni e Manutenzioni Navali, S.r.l.
Location:	Venice, Italy
Organization Type:	Small Shipyard and outfitting vendor
Personnel:	Mr. Renzo Mognato, President/Owner

Business Summary:

MANA is a rather unique business that operates primarily as a small boat yard but recently has developed a specialization designing and building interior decorative panels for the public spaces on cruise ships. The shipyard work is all done in-house including developing specification, drawings, structural design and analysis, and stability analysis. A typical project was nearing completion during the time of this visit. It was a small ferry for Venice. The boat was 25 meters long, displaced 25 metric tons, and carries 120 passengers. It had a top speed of 18 knots. This craft is typical of the yard which can build small ships up to 45 meters in length.

Business Practices:

The most unusual aspect of this yard's business is the subcontracting work which it is conducting for the Disney Cruise Lines ships "Magic" and "Wonder." In these projects MANA is operating as a subcontractor to Hopeman Brothers located in Waynesboro, Virginia. Hopeman Brothers received the contract to provide the turnkey outfitting in Area 5 of these ships. This area includes several public spaces with restaurants, bars, a theater, and the main entrance salon. MANA received the subcontract to design and build several components of this complex including the main stair case, decorative theater wall panels, restaurant windows, and elevator panels. The philosophy for this project was a close cooperation between the shipyard and the vendors. The schedule requires that each ship be built in twenty months. This very fast schedule required that about 20% of the work was completed before the vendor contracts were signed. The first ship, the Disney "Magic" was delivered in mid-1998. On this ship all of the materials in the public spaces were stainless steel. The metal was left unpainted with a sandblasted finish. MANA provided decorate doors, the main stair case, theater stage front and seats, and public spaces balusters with handrails. The first work was for the theater stage architectural panels and seats. This work included artistic design, detailed design, fabrication, and installation. For the Disney "Wonder" the material is aluminum painted with a bronze finish. This work is more complicated than the first ship because of the bronze finish requirement. The Disney "Wonder" work will also include about 20 decorative windows for a restaurant.

The communication requirements for this project were very demanding and international. MANA had most of their interaction with Hopeman Brothers. Initially this via paper

drawings, but very quickly this evolved to the use of emailed CAD files sent over the internet. MANA did their CAD work in AutoCAD 14 and AutoCAD LT. The negotiations were based on price, schedule, and engineering details. Communications were very complex in this project. The architect was located in Norway, the outfitting contractor was located in Waynesboro, Virginia, the owner was located in California, and the shipyards were located in Marghera and Ancona, Italy. MANA needed to have contact with each of these partners at various times. The project was even more complicated as the schedule required that the hull structure to be fabricated in two parts. The forward section was fabricated in the Ancona shipyard and the stern section in the Marghera shipyard. The forward section was then brought to Marghera where the two parts were jointed and the outfitting work was conducted.

MANA was responsible for the detailed artistic design which was defined on CAD and submitted to the owner for approval. If the design was acceptable to the owner and within price then Hopeman brothers would authorize the work. During the design process MANA would first check if it is was possible to save money, reduce weight, or improve the appearance by modifying the preliminary design. MANA would take a look at the entire project and suggest changes. This working relationship has developed over on 18 months of experience and has been shown to work well. As an example of the improvements possible, MANA has revised the supports for the architectural panels saving about 120% on the installation labor costs for the second Disney ship over the first.

For each task, Hopeman Brothers sent detailed drawings for use by MANA. However the subcontractor also field checked all measurements prior to beginning the design work and created his own drawings based on these measurements. The MANA drawings were then sent by email to Hopeman Brothers were they were incorporated into the outfitters drawings

The work included balustrades on Studio Sea located on Deck 7. All of the balustrades, posts, and hand rails and custom made from stainless steel. The handrails were fabricated from wood with stainless steel connecting pieces. The posts and decorative details in the staircase balustrades were fabricated from solid stainless steel. Decorative glass panels with star appliques were supported between the posts. Another major fabrication was the grand staircase located in the entrance hall on Deck 6. The pattern included outlines of several Disney characters. The stainless steel was laser cut by a subcontractor to MANA. The stainless steel elements were rolled as necessary and assembled and welded at MANA. Usually the work required preparation of a sample.

The working relationship between the subcontractor, outfitting integrator, shipyard, and owner was truly remarkable. It required a tremendous amount of two-way transfer of information. It was necessary for all parties to understand and respect the expertise of the others. In this way each party was able to use their expertise to maximum effectiveness. As subcontractor it was necessary for MANA to understand the final product and how the work was to be integrated into the whole. This allowed MANA to apply their knowledge of working with the materials to facilitate the work of Hopeman Brothers. Their goal was

to minimize the use of labor for fabrication and installation. Frequently MANA made suggestions to revise the design. Their responsibilities included all aspects of the work in a true turnkey effort including artistic design, structural design, detail design drawings, material cutting, rolling and fabrication, finishing, and final assembly onboard the ship. MANA has also received direct orders from Disney to make adjustments to work done by other vendors.

This complex and dynamic process is not one that is defined and directed by specifications and data formats. Rather the working relationship and skill of the partners is most important. The work is highly decorative, but requires a solid knowledge of fabrication and structural design. As such it is truly the pinnacle of the ship building art for cruise ships today. The process is even more remarkable considering the international makeup of the players and the use of the internet for communication and integration. However, it was not possible to rely strictly on fabrication drawings as the outfitting work developed by MANA was always begun with as-built field measurements of the ship steel structure.

Appendix E SADI - Decorative Architectural Panels, Ceilings, and Sign Systems

Vendor Furnished Information Interview Report

Date: 10/29/98
Company: SADI, S.p.A.
Location: Vicenza, Italy
Organization Type: Manufacturer of decorative architectural panels, ceilings, and sign systems
Personnel: Mr. Giuseppe D'Imporzano, Managing Director
Ms. Anna Maria Indri Raselli, Marketing

Business Summary:

SADI was founded in 1908 and has annual sales of 80 million dollars per year. About 20% to 25% of its business is in the marine sector which employs about 200 people. They have been involved in the ship building business for about 55 years principally in the architectural panels for public spaces, cabins, and suites. About 80% of their marine business is to Fincantieri including ceilings and sign systems. They are subcontractors to Hopeman Brothers for the Disney ship projects.

Business Practices:

The vendor gets involved in the ship project during the conceptual design phase. Here they discuss the possibilities with the architect and the naval architect. They provide information that can be incorporated into the design. During the conceptual design they are involved with the shipyard and make an offer of the rough price. After the shipyard gets the order, it will then involve the vendors who make application. Shipyards have different ways of dealing with vendors based on their material management systems. Each shipyard has unique needs and philosophies. In southern Europe, including southern Italy, Spain, and France; the shipyards tend to purchase materials and systems in smaller components. This minimizes the material costs, but increase the labor costs and often increases total costs. In northern Italy, Finland, and Germany; the shipyards tend to ask more for the a turnkey approach. This includes panels, ceilings, flooring, furniture and electrical systems, and HVAC. The turnkey supply is a complete outfitting system philosophy that includes design, manufacturing, and installation.

Some shipyards have the problem of maintaining a work force. These shipyards tend to do more work in house therefore they do not make full use of the capabilities of a vendor. Other shipyards are trying to optimize cost with a relatively small workforce and a lot of outsourcing. The best model is probably to use the automotive manufacturer approach which maximizes the use of vendors and their capabilities while the auto maker focuses on the core business, the complete system.

The leading yards develop a vendor list of those vendors with good capabilities and competitive prices. These vendors maintain an office close to the shipyard to develop

and maintain a co-maker relationship. The shipyard tends to be an assembler of components operating in the shortest time and at the least cost. The automotive industry can rely on the use of prototypes which is impossible for ship building. Therefore the shipbuilding industry must study the starting preliminary design properly. It is necessary for all of the actors to enter into the discussion including the shipyard, naval architect, and suppliers. It is a common defect that all players are not involved in major discussions. Typically, the shipyard will interact with the naval architect or the shipyard will have discussions with the vendor. There is therefore a 15 to 30 day delay before the vendor is brought into the discussion. This is quite significant as the total lead time may be four months. For example, the owner will work with the naval architect. Then the design will be given to the shipyard. Often the design is not given to the vendors at this phase. The shipyard does not know if the design is expensive or not. The shipyard will make a rough evaluation based on their experience. The bid is offered and the order is made. The shipyard produces drawings, but does not communicate them to the vendors until months later. At this point several vendors are asked to make revisions to optimize the profits. In a large cruise ship this may involve fifteen large areas. The vendor will often have one or two weeks to reply and therefore finds it very difficult to respond in any depth.

The solution is to select the vendors and get them involved early in the project. This can be done without making the vendor a partner. For example, SADI proposed to a shipyard that they could decrease the price in one area by 20% if given the time to evaluate the design and offer suggestions. The results were actually a 27% decrease in price.

SADI found Hopeman Brothers to be very successful in their approach on the Disney ships. Hopeman Brothers understood the importance of integration. They were able to approach the problem in an integrated fashion. On the Disney ships, Hopeman Brothers provided a complete turnkey solution to the outfitting of a complete area. The project has advanced to the second ship , the Disney “Wonder”. It is now easier to refine the solution because this is a follow ship. The relationships have already been developed so more effort can be applied to the technical work. SADI is providing ceiling systems and sign systems for Hopeman Brothers in the Disney ships. The sign systems are about 1 million dollars per ship. SADI is making the components and has a close involvement in the design with Hopeman Brothers. The design group for Hopeman Brothers is located in the USA. Communication is via email. CAD drawings are also sent back and forth.

SADI’s experience in the AEC, Architecture Engineering and Construction, industry differs from the shipbuilding industry. In AEC work SADI will enter the project much earlier. There is much more integration and sometimes they will provide all work in a whole area. SADI is expanding their business capability to provide a turnkey solution.

In the shipbuilding industry the approach should be to select partners who are able to optimize the system during the early stages of design. If the ship is broken into the smallest possible components the tendency is to kill the product. If the ship is attacked as a whole the tendency is to kill the price. The relationship between vendor and shipyard should be based on commitment and mutual knowledge. The current practice is to select

vendors based on a questionnaire which results in a very formal, rigid, and fragile relationship.

An example of how this partnership can result in lower cost can be seen in the ceiling materials. Current fire certification requires the ceiling material to withstand fire for 15 minutes. SADI makes a line of products that will withstand fire for 30 minutes. Using this product will reduce or eliminate the need for insulation above the ceiling. This would be a cost savings for the shipyard. However, SADI has been unable to interest shipyards in this product because of their bureaucratic nature. No one department has total responsibly. Therefore the advantage of this product is not appreciated.

Mr. D'Imporzano has significant experience with ISO 9000 and quality. He had experience running the second company in the world to receive to ISO 9001 certified. This company was a supplier to Ford. As a result of his experience, he was teaching quality seminars to IBM. Mr. D'Imporzano noted that most shipyards that implement the ISO 9000 process do not fully understand the potential that this process has for quality improvement. If this process is fully understood and utilized it can be very valuable. The ISO 9000 process sets up a system of customers that relate to one another. The disadvantage can be to kill creativity through the use of overly prescriptive documentation. Documentation alone can not encourage creativity. However, the process is better than confusion. The advantage of the ISO 9000 documentation is to provide information, which can then be used to improve quality.

Mr. D'Imporzano sees opportunities for improvement in the future. Integration must come from the shipyard and the vendor working more closely. Presently the relationship can be antagonistic not cooperative. There is a need for more of a partnering attitude, as is done in the automotive industry. This will ultimately result in a reduction of vendors and a greater specialization of vendors. The remaining vendors will team more closely with the shipyards. This method of conducting business could come in the next two to three years. There is also a need to be more concerned with integration. This is especially important when considering organizational changes. SADI has changed their industrial approach in the last four to five years. They are developing standardized procedures to make customized solutions. These procedures include standardized ways to use equipment and processes. This provides the means to know the costs for a tailor-made material. Another thing that gives flexibility is to be open to new technologies. One SADI innovation is the use of plaster in place of wood to increase the fire proofing. The vendor is now working with gypsum, metal, and wood in one facility. They are building a network of inside production combined with outsourcing. They feel that the region of Italy in which they are located is a unique area to do this kind of networking. The Italian craftsman is unusually committed to high quality work and will be zealous in pursuing perfection.

Appendix F - Marine Equipment Pellegrini, Deck Machinery

Vendor Furnished Information Interview Report

Date: 10/29/98
Company: Marine Equipment Pellegrini, S.p.A
Location: Verona, Italy
Organization Type: Deck Machinery, Davits, Cranes, Hoists, and Anchor Handling Gear
Personnel: Mr. Giuliano Moretti, Managing Director

Business Summary:

Marine Equipment Pellegrini is a network of companies that is very flexible. The principals are also the engineering personnel. They cover all aspects of the equipment including hydraulic, electrical, and mechanical. The core business has about 15 employees and does 15 millions dollars of business per year. The present form of the company came about when the larger parent firm was broken down into a number of smaller companies, each with some manufacturing capabilities. These smaller subcontractors provide a high degree of flexibility. The complete manufacturing capability includes anchor winches, mooring and towing winches, capstans, marine cranes, overhead bridge cranes, gantry cranes, boat davits, lifts, and hoists. In Italy they are one of the few suppliers that makes winches and cranes. Principal customers are shipyards and the offshore oil industry. Their market is 50% Italian and 50% international. In Italy they have a traditional connection with the marine industry and the Italian Navy including equipment for submarines. In Italy they are the only supplier who makes winches and cranes. The business operates principally as an assembler with 80 to 90% of the components purchased not built.

Business Practices:

Their philosophy is to focus on the ship, not separate pieces of machinery. They respond to the shipyard request for proposal and specification. Sometimes the shipyard specification is very clear. For example the specification for the boat crane for the LPD 17 was very clear. The crane required low radar signature and greater capacity than normal cargo and boat cranes of similar size. The requisition also included the boat handling device and costs for follow ships including non-recurring costs. This specification was very clear and did not require a lot of interaction. But if the information in the specification is unclear, then some discussion with the shipyard is necessary. The company makes 25 to 30 types of cranes, the first job is to identify what the shipyard or owner wants. The interests of the owner and the shipyard do not always coincide. For instance, Fincantieri reduced the characteristics of the crane for the Sea Princess, but the owner was not satisfied with the results. Vendors normally interact with the shipyard and do not interact directly with the owners.

The philosophy is to provide a compete suite of equipment. Proposals are usually for a suite including the deck machinery (windlass, mooring winch and capstans, towing winch, special winch), cranes (including cargo crane), boat davits (including free fall davits), and the davit for rescue boat which is usually a RHIB. Recent SOLAS rules require fast rescue boats for all fast ferries. The davits for these boats include shock absorber and constant tension winch.

The relationship with a large shipyard is usually very formal. Contact is made through the purchasing department. There is usually little communication directly with the shipyard technical personnel. Technical personnel will communicate with the purchasing department who, in tern, will deal with the vendor. This makes it more difficult to work out problems if, for instance, the specification has technical flaws. The negotiation may take three to four months leaving little time for manufacturing and delivery. There is considerable pressure to reduce costs through competing three or four vendors. The awards are often divided based on lowest price with different vendors receiving awards for deck machinery, davits, and windlasses. As a result the cost of system maintenance will be higher to the owner as he will have to deal with several suppliers throughout the life of the ship. Cost of spares is also higher, as there is no chance of common components. Finally, the installation cost will also be higher when components are purchased separately. If one vendor were to supply all machinery, davits, and windlasses then a single crew could be sent for installation and tests. This would lower the cost to the shipyard. An example of such lower costs is the recent supply of equipment to a shipyard in Denmark. This yard has made a number of chemical tankers with the deck equipment suite very much alike. Marine Equipment Pellegrini supplied deck machinery, hydraulic power packs, cranes, life boat davits, and rescue boat davits. It was possible to send one technician to install and make operable all elements.

In medium size shipyards the manager of purchasing is more accessible. This individual often has a technical background. These shipyards build ships up 130 m in length and usually specialize in a particular ship type. The purchasing manager is also the technical manager. These yards will evaluate on the basis of quality and service in addition to cost. It is possible to communicate on a more personal level. Therefore the medium size shipyards are more efficient than the large shipyards.

This vendor has sometimes found U.S. Navy MilSpecs to be obsolete. For instance a particular hydraulic pump was required by MilSpec for a davit on the *Osprey*". When Marine Equipment Pellegrini compared a MilSpec rate pump to their own product that found the MilSpec product would cost 10 times as much and be only 1/3 as efficient as the equivalent commercial pump.

In the past, Fincantieri, has implemented a number of purchasing systems. These systems involved asking vendors to provide a list of equipment and prices that they are willing to supply. The shipyard would contact many suppliers throughout the world. A list of preferred vendors would then be developed for these products. The preferred vendors would agree to supply their equipment for two years at a discount cost. However, the agreements do not seem to last very long. Marine Equipment Pellegrini was enrolled as a

preferred vendor for deck machinery and engine room cranes up to nine metric tons. However, the day following the ratification of this purchasing agreement, a normal purchase request was received from the shipyard.

Marine Equipment Pellegrini has proposed to be a partner with shipyards. This arrangement would allow the vendor to enter into the project from the first step. The vendor would agree to protect the shipyards proprietary data in return for the opportunity to review the design early in the project. The vendor would then be able to assist the shipyard and offer a discount price. The purchasing partner, the shipyard, would then select the vendor partners. Little and medium shipyards are agreeable to this approach. Large shipyards are hesitant to work this way.

Appendix G Officina Forcato - Lights

Vendor Furnished Information Interview Report

Date: 10/28/98
Company: Officina Forcato
Location: Verona, Italy
Organization Type: Manufacturer of Navigational lights and cabin light
Personnel: Mrs. Forcato, Owner

Business Summary:

Forcato is a family owned business that has been manufacturing navigation lights and interior ship and yacht lighting since 1909. They are the only company in Italy that makes brass and glass navigation lights. The company has about 10 employees and does about 1.2 million dollars of business per year. The vendor supplies high quality lighting fixtures that eliminates them from many markets where cost is the most important factor. In recent years plastic navigation lights often chosen over their products as they are cheaper.

Business Practices:

The cruise ship business is a major source of revenue for the vendor. Sometimes they are called upon to investigate new technology. For instance new rules for fire protection on cruise ships require that no holes be made in the ceiling of cabins. The lighting vendor has been asked to provide a solution for this requirement.

In this business the architect selects the appearance, but the supplier must provide a light that meets all of the regulatory requirements. In the cruise ship business the architect will build a mockup of cabins and public spaces. The lighting suppliers will be asked to provide written a proposal and samples of lights to meet the specification. One of these lamps will be selected and installed in the mock up. The lamp designs are not copyrighted, so each supplier will then be asked to submit a bid to supply the chosen lamp. The lowest price bid will win the contract. For large cruise ships there are several suppliers with different ones chosen for public spaces and cabins. Large orders over 2,000 lamps will usually go to larger vendors. Forcato will usually win orders for smaller quantities of specialty lights.

For navigation lights, the owner will usually decide the material. In Italy, Forcato has the market on glass and brass lights. They are not competitive in plastic lights. Plastic lights will deteriorate with time, but can be replaced in expensively. Some cruise lines such as Costa Crociere and Carnival still prefer glass and brass. The cost of navigation lights is quite small in comparison to the total ship cost.

Appendix H - Pompe Garbarino - Pumps

Vendor Furnished Information Interview Report

Date: 10/30/98
Company: Pompe Garbarino, S.p.A.
Location: Acqui Terme, Italy
Organization Type: Manufacturer of Pumps
Personnel: Mr. Carlo Garbarino, Technical Director
Mr. Mario Garbarino, President and CEO
Mr. Alberto Dallari, Export Sales Manager
Mr. Franco Parodi, Technical Manager

Business Summary:

This is a family run company that has been supplying pumps for 65 years. The company began to supply the Italian Navy pumps after World War II. These pumps had to meet a strict naval criteria for shock, vibration, and noise. They found that being qualified for naval ships was a good qualification for merchant vessels. The company began to export their pumps in the late 1980's. They developed an export consortium supplying pumps to the top world shipyards. They are ISO 9002 certified. They often make use of specialized engineering companies to develop new designs. The build the prototypes in-house. All pumps are manufactured in their main facility. They employ about 70 people and do about 15 million dollars of business annually. About 75% of their business is marine. They include all of the major European shipyards, Southeast Asia shipyards, and far east shipyards in their customer base. Their scope of supply includes centrifugal pumps for ballast, bilge, cooling systems, and fire fighting pumps. They supply gear pumps for fuel oil and lube oil. They often sell pumps to A/C suppliers, sewage contractors, and hydraulic contractors.

Business Practices:

They enter into the design process when the shipyard submits for bid an equipment list accompanied with a thick technical specification. The vendor will sometimes suggest substitutions that will make for lower costs, better life, or improved performance. Most of the failures of pumps are in the sealing systems, so they pay particular attention to seals. The shipyard will break down the requests for quotations by system. The quotation prices are itemized by item but the award is often given for the entire ship set. The exceptions are the economizer boiler feed system or bilge pumps which may be supplied under separate order.

In 1993, Pompe Garbarino was approached by Fincantieri and other shipyards. These shipyards were approaching vendors to ask for lower costs. In response, the vendor revised production costs and submitted a tender. Since 1994 they have been preferred suppliers of pumps for Fincantieri and some Spanish shipyards. Under this agreement they guaranteed their costs for three year. These agreements were renewed in 1997. The

agreements are for a guaranteed price at an indefinite quantity with a guarantee minimum order per year. The preferred vendors are not the exclusive vendors, but they are preferred if the owner has no objection. At the bid stage Fincantieri knows and will use the quoted price. At the building stage Fincantieri will ask for a quote. This allows the pump vendor to comment on the order and review the specification for technical correctness. The agreement does work for the vendor in providing an increased level of business and a steady source of business. The shipyard has the ability to know price early in the program. The agreement does not guarantee the order for the vendor. It is still necessary for the vendor to bid. If the owner asks for another vendor at a lower price, then the preferred vendor may have to lower his price or lose the bid. Shipyard buyers keep lists of all bids. This information is used to assure the preferred vendor price is competitive.

There have been rumors about the shipyards requesting pump suppliers to enter into a partnering agreement. So far this is only a rumor. The partnering with the pump vendor has some difficulties. At present the piping system is designed by the shipyard or a design agent. The vendor believes it would be better if the fluid handling system personal were involved in the fluid system design. This would eliminate some difficulties that have arisen in the past. For instance, there is a continuous need to simplify the system. Therefore some specifications call for the same pump to be used for firefighting and general service. This cost saving measure is possible by installing a two speed electric motor on the pump. However, if the requirements are too diverse, combining a very low head requirement with a high head requirement, then the pump may be operating at the extremes of the pump curve and cavitate in one of the services. In this case the vendor could make a recommendation to change the specification, perhaps raising the low pressure requirement to provide a pump that will always operate satisfactorily. Another area where problems have arisen is the design of parallel feed pumps in the stack economizer boiler. Some designs have laid out so that one of the pumps did not get any flow. This problem was not discovered until the ship was in service. This was a design configuration problem, not a pump problem, but the pump vendor was required to assist in devising a solution as his equipment was suspected to the reason for the failure.

The pump maker would like to get more information from the shipyard on some specific requirements. However, the pump maker is not in a position to review the entire fluid system design unless there is a charge for this service.

Another issue with this vendor is quality. Their products are manufactured from aluminum bronze with large cast bases that are not subject to vibration and noise. Cheaper solutions are noisier. Shipyards are usually interested in the lowest cost solution that will satisfy the owner. They are not often interested in quality, just price and delivery. Therefor it may be helpful to present the product to the owner directly. This would make the owner aware of the advantages of higher quality which could become an owner requirement.

This vendor is a small flexible company that has significant experience providing shock proof, low noise, low vibration pumps. In a recent cooling system design, they revised their largest pump to increase the output to meet the requirements for the project.

The relationship and communication with smaller shipyards is less formal than larger shipyards. This is true even though all shipyards are qualified and certified so the same procedures must be followed. Never the less the relationship with smaller yards is more flexible. Suppliers need to establish professional relationships with their counterparts in the shipyards. The vendor would like to be involved in critical system design including the economizer circulation system and self priming systems on large pumps during the design process prior to being presented with a program. In the past this vendor has provided training courses for new designers at the shipyard. This was a three day course provided at the request of Fincantieri. In addition, the vendor often has teams of foreign naval officers resident at their factory to become familiar with the pumps and their operation.

APPENDIX F

Vendor Furnished Information Development Guidelines, Method for Shipyard Implementation, (Viewgraph presentation).

Vendor Furnished Information Development Guidelines

Method for Shipyard Implementation

Project 6-96-2

VFI

Shipyard Implementation

Purpose of this presentation

- To explain why the project was undertaken
- To describe how it was undertaken and its conclusions
- To explain the VFI system
- To explain how to implement the system in a shipyard

Definition of VFI

Vendor Furnished Information (VFI) is the information provided to the shipyard by the vendor to support the design of the ship and the procurement, installation and operation of the equipment.

VFI

Shipyard Implementation

U.S. / International commercial shipbuilding comparison

Design and build cycle time

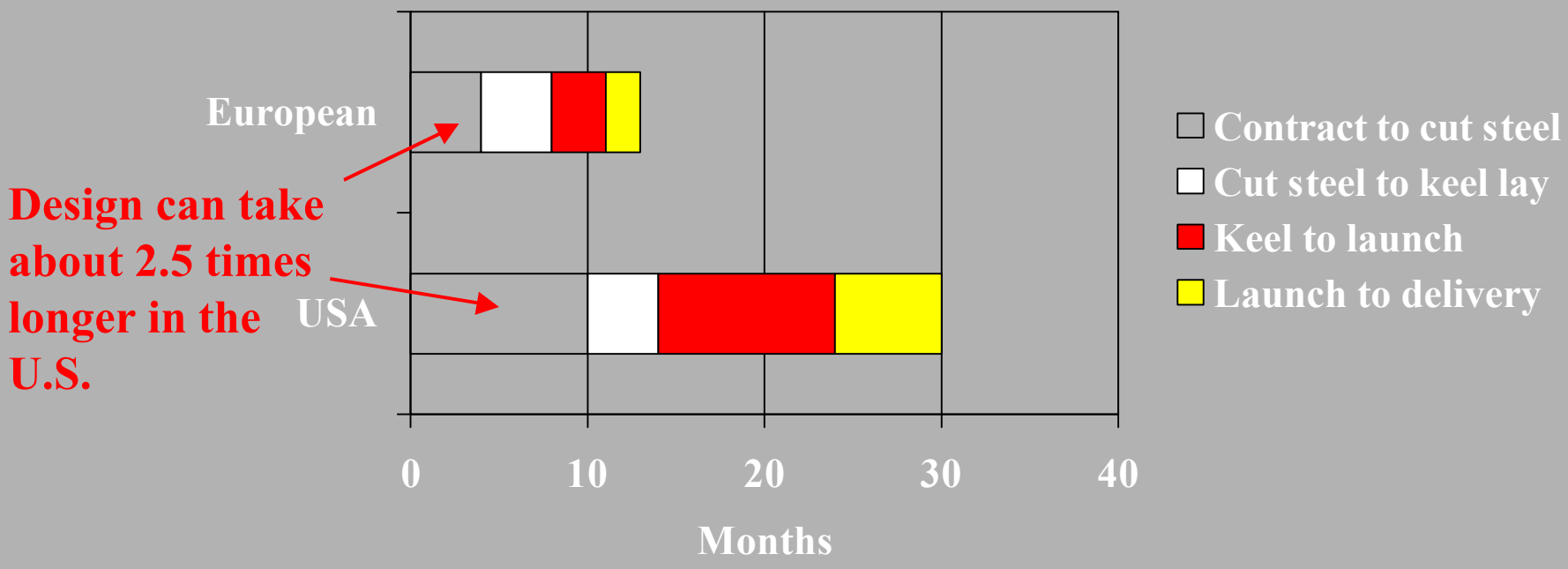
Material and equipment cost

VFI

Shipyard Implementation

Design cycle time

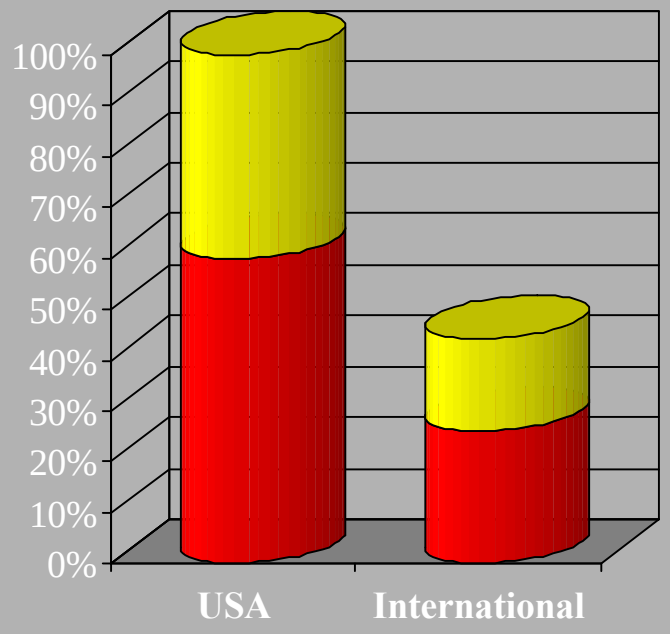
Typical Suezmax Tanker Schedule USA & Europe



Typical dock time for a Suezmax tanker in Japan is 50 Days

VFI → Ship cost

Shipyard Implementation



Observations:

- Overall breakdown similar
- U.S. material and equipment cost higher
- U.S. pre-production and production costs higher

VFI

Shipyard Implementation

Conclusion

U.S. shipbuilders must reduce design cycle times and the cost of materials and equipment if they are to become internationally competitive

VFI

Shipyard Implementation

Reasons for the difference

U.S. design and procurement practices based on DoD rather than commercial requirements

Very little use of high level (i.e. ship type) and detailed standards

Lack of co-ordinated VFI strategy between estimating, design, procurement and vendors

Virtually no vendor partnerships in U.S. shipyards

U.S. vendors often unenthusiastic about shipbuilding projects due to practices adopted by shipyards

U.S. yards often have limited supply base.

VFI

Shipyard Implementation

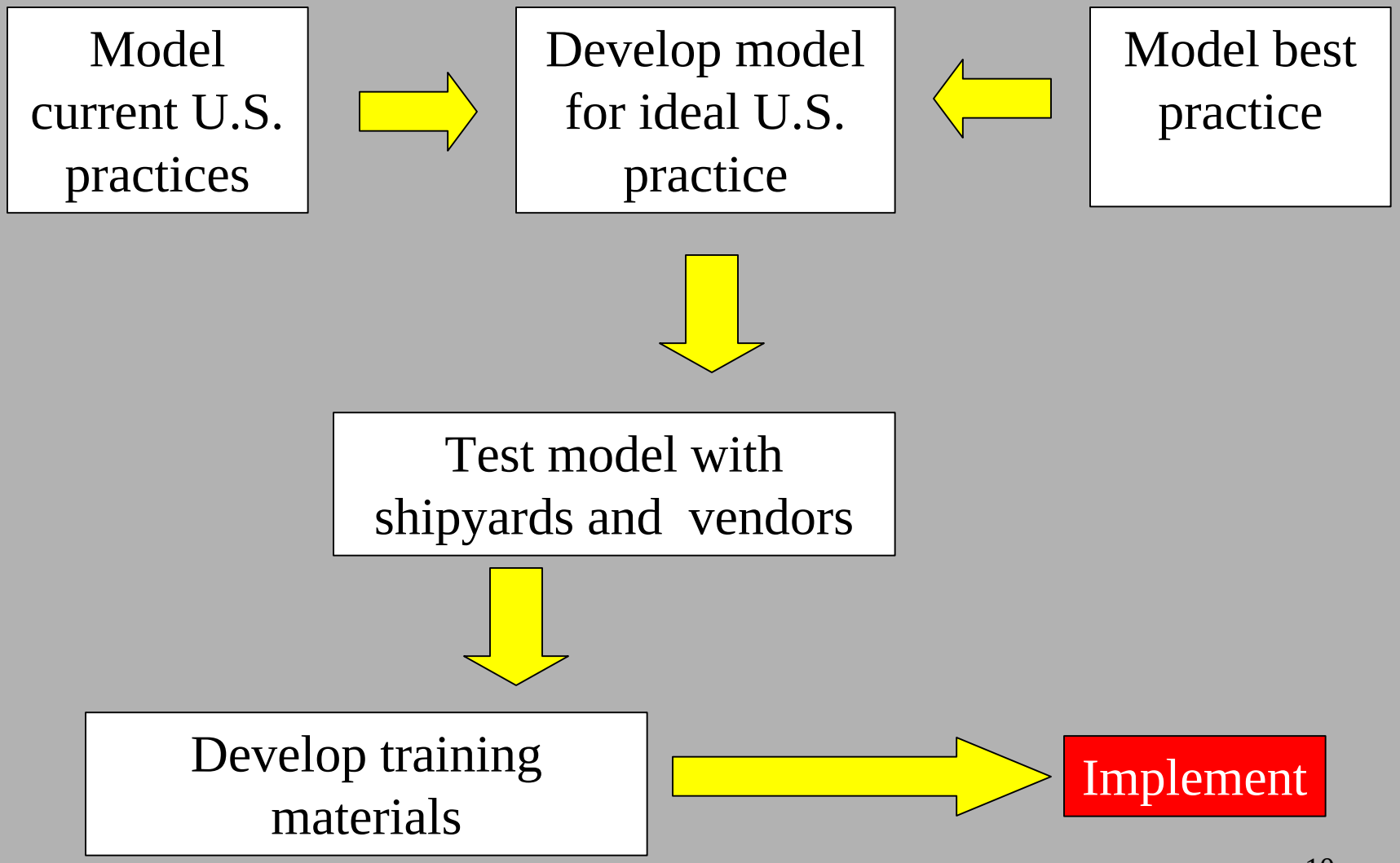
Project objectives

To assist in improving the international competitiveness of U.S. shipyards by producing……..

- Identifying how the U.S. design process could be modified to ease the problems created by the supply of VFI
- a system to specify and co-ordinate the supply of Vendor Furnished Information

VFI Approach

Shipyard Implementation



VFI

Shipyard Implementation

Input and involvement

Project contributors included……

- U.S. shipbuilders
- U.S. design agencies
- U.S. vendors
- European shipbuilders
- European vendors
- European shipbuilding consultants

VFI

Shipyard Implementation

Design / procurement model

Key Features……..

Partnership with preferred vendors

3D CAD models with database of attributes

Detailed standards for:

materials & equipment

structural components

layouts etc

VFI

Shipyard Implementation → **VFI system**

Key Features……..

Provides structure to information requirements

Aligns the supply of information to the design process

Reduces: lead time

shipyard administration costs

supplier costs (and equipment price)

human error

Improves shipyard competitiveness

VFI

Shipyard Implementation

Types of VFI

Documents and data relating to……..

- Contract / Administration
- Mechanical aspects
- Electrical aspects
- Certification
- Installation
- Quality assurance and control
- Weight control
- Instrumentation
- Spare parts
- Operations and maintenance

Can be either in paper or electronic format

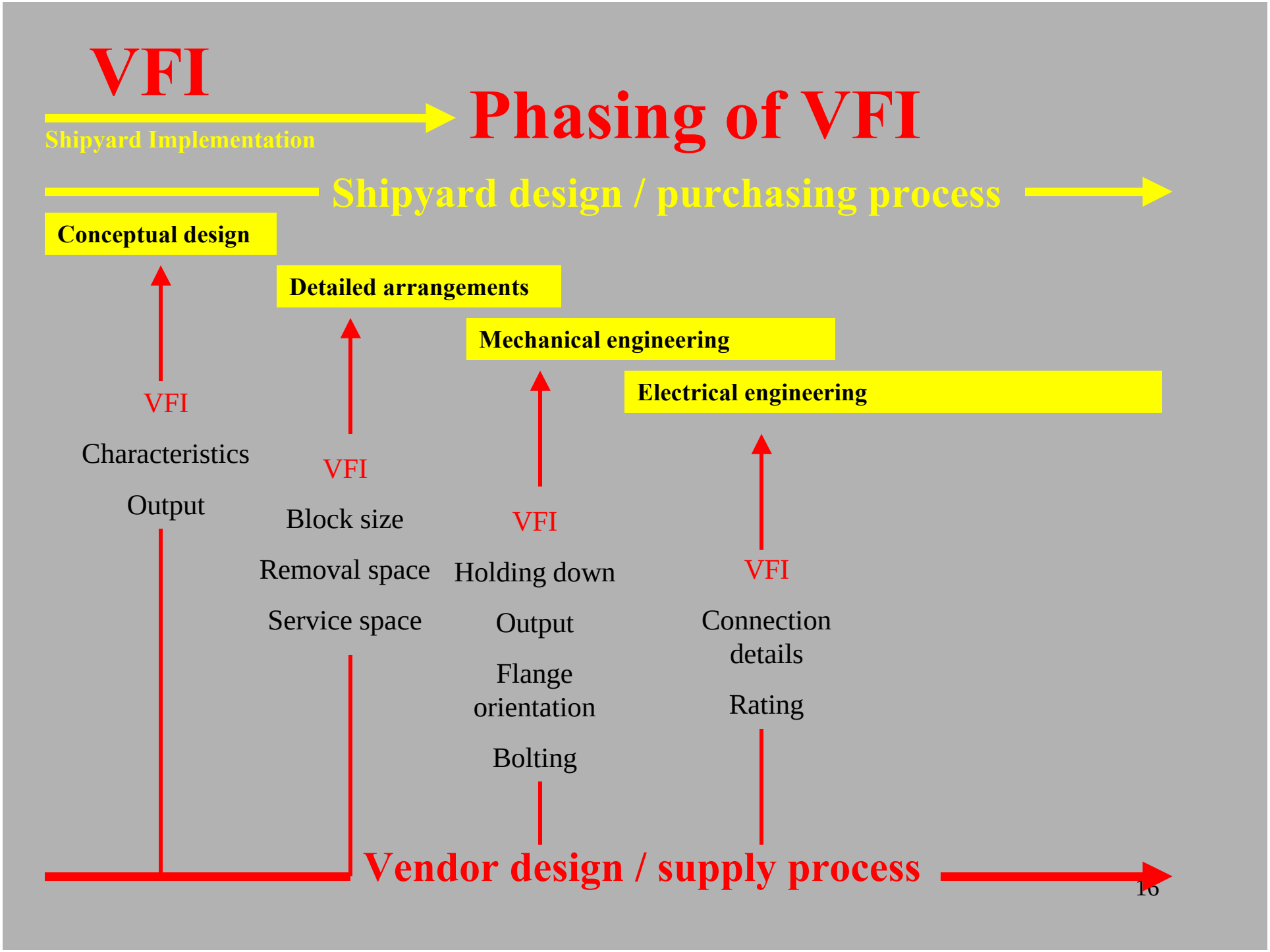
Types of VFI

86 items of VFI have been identified

Only a selection of them apply to each piece of equipment

A database system can be used to pick out the appropriate items

Pre-sets in the database for each type of equipment


VFI
Shipyard Implementation
Phasing of VFI
Shipyard design / purchasing process
Conceptual design
Detailed arrangements
Mechanical engineering
Electrical engineering
VFI
Characteristics
Output
VFI
Block size
Removal space
Service space
VFI
Holding down
Output
Flange orientation
Bolting
VFI
Connection details
Rating
Vendor design / supply process

VFI

Shipyard Implementation

Key dates

Information is related to the following key dates……..

- Submission of the bid to supply equipment
- Purchase order issue date
- Factory acceptance trials
- Dispatch from vendor
- Receipt in the shipyard

There could be others

Key dates can be changed to align with procurement processes

VFI

Shipyard Implementation → **VFI matrix**

The 86 items of VFI are presented in a matrix

Grouped by information type

Specifying the required date

Example for VFI relating to QA / QC shown on next slide

VFI

Shipyard Implementation

VFI QA / QC matrix

1 Quality Assurance and Quality Control

VIRL NUMBER and DESCRIPTION		REQUIRED DAYS				
		With Bid	Draft for review	Final Docs reqd	Delivery with equip	Archived by Vendor
Q01	CORPORATE QUALITY MANUAL Vendor's manual detailing quality policies, procedures and organisation. Quality System Approval Certificate by Accredited Body.	Yes				
Q02	PROJECT QUALITY PLAN Vendor's QA plan detailing organisation and procedures specific to this project.		Yes	4 wks after PO		
Q03	QUALITY INSPECTION AND TESTS Inspection plan indicating specific quality activities – tested by, witness by, etc.		Yes	4 wks after PO		
Q04	PROJECT PLAN A plan is to be submitted for approval showing how and when events are to be achieved from award to shipment. Key dates including documentation issues as required by this VIRL to be shown.		Yes	4 wks after PO		
Q05	PROGRESS REPORTING Monthly progress reports against the project plan are to be provided.		Yes	At PO		
Q06	BUYER'S INSPECTION Items/equipment will be subject to on-site inspection prior to despatch.				Prior to despatch	

* Note:- Archived by Vendor means that it shall be the responsibility of the Vendor to retain this information for the duration of the Guarantee Period.

VFI

Shipyard Implementation

Status of the information

The matrix also indicates if……...

- a draft for review is required
- when the final documents are required
- the information should be archived by the vendor

Further simplified if standards are used

VFI

Shipyard Implementation

Data sheets

Need to standardize how the data is handled

Applies to both procedures and the format of data

Example data sheets for…….

Weight control	Motors	Lubricating oil
Noise	Spares	Tools
Commissioning spares		Insurance spares

……..have been included in the text

An example of a tool list is on the following slide

VFI

Shipyard Implementation

Tool list data sheet

TOOLS LIST

ANNEX F

SHIP NUMBER:-	
SUPPLIER NAME:-	
ORDER NUMBER:-	
MATERIAL NUMBER:-	
EQUIPMENT NAME:-	
TAG NUMBER:-	

Working No. Per Set	
Depot No. Per Set	
Description	
Re-Ordering No.	
Price	
Remarks	
Upplier's Spares Department Address: Telephone: Fax:	

VERIFIED		DATE	

ONE SHEET TO BE COMPLETED FOR EACH INDIVIDUAL BUYER MATERIAL NUMBER WITHIN THE SCOPE OF SUPPLY

VFI → Implementation

Shipyard Implementation

Method can support current and proposed U.S. design process

Could adopt a phased approach:

Short term - rationalize VFI in existing organization

Medium term - update design processes and adopt standards

Longer term - move towards full vendor partnerships

Looking at short term implementation…….

Implementation steps

Set up a project team and steering committee

Study VFI project documents

Discuss with vendors

Address the key steps outlined in the slides following

Educate all relevant shipyard personnel (using a modified version of this presentation)

Educate all vendor personnel (using a modified version of the pre-prepared vendor presentation)

Implementation organization

Small project team of say three people who are off-line to do the work, plus a steering committee

Steering committee should consist of representatives from the following departments:

- Estimating
- Preliminary design
- Engineering (all areas)
- Purchasing
- Quality assurance
- Production
- Tests and trials
- After-sales support

VFI

Shipyard Implementation

Setting up the system

Key points……..

Understand the current design process - *as has been shown, the design processes can be rationalized to reduce the need for detailed VFI to be supplied early on. However, if the existing design process is understood, the VFI requirements can be identified and the phasing determined even though the existing process may be sub-optimal.*

Review and modify the VFI requirements list - *the matrix of the 86 items of VFI can be found in the project documentation. This should be reviewed to make sure it includes all items needed by a specific shipyard.*

Decide which items of VFI are required for each product type - *only a few of the 86 items are required for each type of equipment. Standards for VFI requirements by equipment type should be established.*

Setting up the system

Key points continued……..

Create database to ensure consistency in VFI requests - *this database will allow comprehensive requests for VFI to be created easily when issuing tender documents. It should have a table which contains a complete VFI list and another which relates this list to particular types of equipment.*

Match the phasing of the supply of VFI to the design process - *understanding the VFI requirements of the design process allows each item of VFI to be supplied at the correct time. The correct phasing of information avoids putting the vendor under unnecessary pressure or stalling the design process while the shipyard waits for unnecessarily detailed information to arrive. A standard schedule should be established for each type of equipment. This can be built into the database.*

Setting up the system

Key points continued……..

Develop standard formats for vendor responses and data sheets - *standardization reduces the time required to complete each transaction. It ensures that the information collected meets all requirements and reduces the chance of forgetting something. A standard format for vendor responses should be adopted which includes data sheets similar to those shown in the documentation .*

Include list of VFI required with requests for tenders - *the vendors ability to meet the VFI requirements must be established at the tender stage to avoid problems down the line.*

Vendor response to VFI request to be one of the selection criteria - *as far possible vendors who can meet the VFI requirements should be selected. The shipyards VFI requirements may be unreasonable so some negotiation may be required.*

VFI

Shipyard Implementation → **Organization**

Arrange for a single point of contact at each stage - *a single point of contact between the shipyard and the vendor reduces the chance of creating confusion and asking for duplicate information. It also guards the shipyard s contractual position and ensures that all dealings between the the vendor and the shipyard are co-ordinated. The single point of contact can be varied at each stage in the design / procurement process but after the contact design is complete, it is preferable to have just one.*

Arrange for information to be passed between departments - *good communication between departments avoids rework, redesign and asking questions twice. All of these things extend lead time and increase the cost of design and procurement.*

VFI

Shipyard Implementation → **Organization**

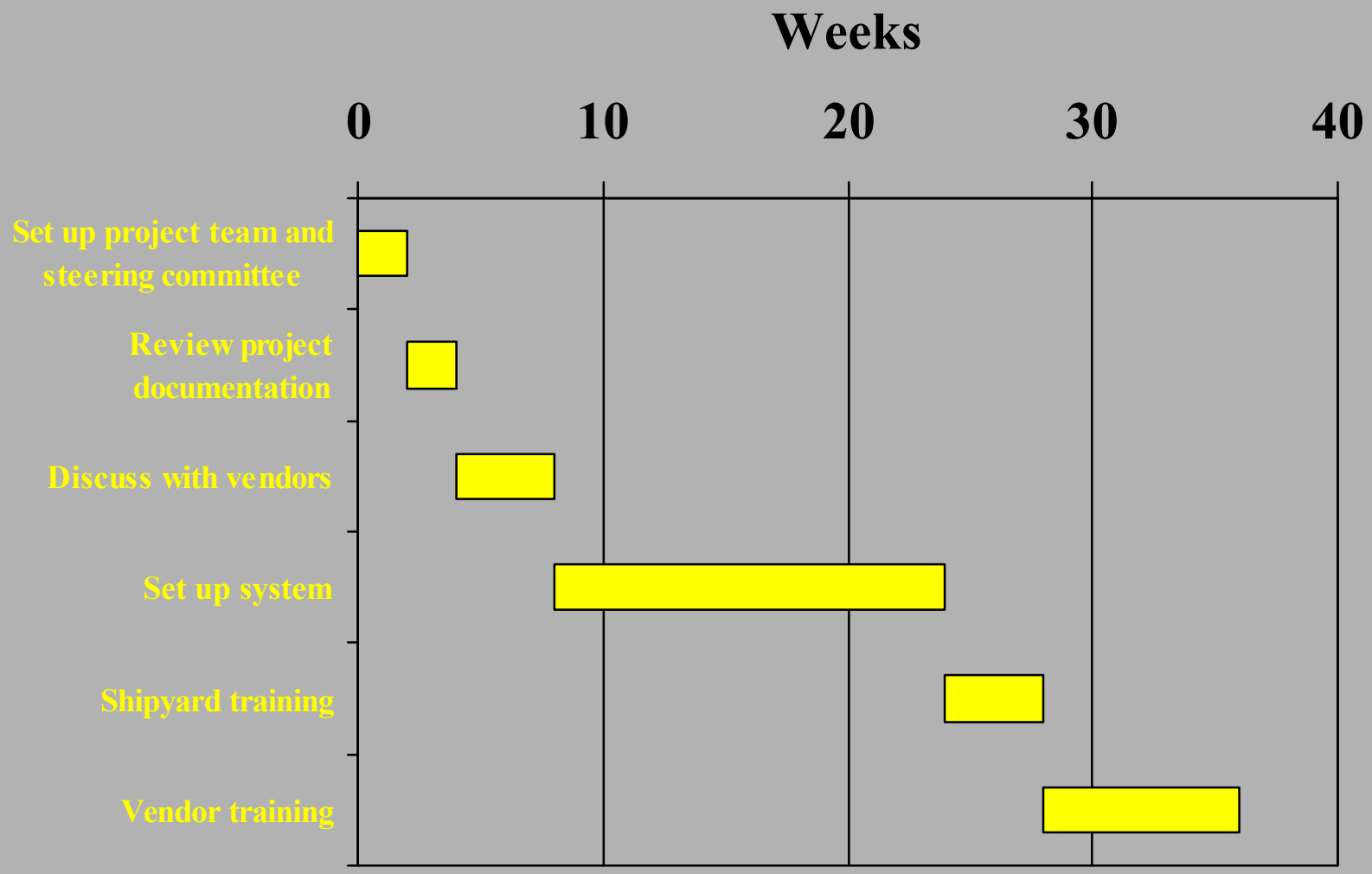
Define the how and where VFI will be received - *often the most efficient way to receive equipment is that it is delivered line-side when it is required directly from the vendor. The same is true for VFI. The vendor should deliver it directly to where it is needed in the organization in the form that it is required. This information should be included in the VFI database.*

Determine how VFI will be tracked and expedited - *VFI is just another deliverable and should be treated as such. It needs to tracked and expedited. This is made more complicated by the need for VFI to be received in different places at different times. Many purchasing systems can already handle this but, if this facility is not available, perhaps an intranet based solution would be the most effective.*

VFI

Shipyard Implementation

Implementation time-scale



VFI

Shipyard Implementation

Future implementation tasks

Modify the design process

Develop vendor partnerships

THE END

APPENDIX G

Vendor Furnished Information Development Guidelines, Implications for Vendors, (Viewgraph presentation).

Vendor Furnished Information Development Guidelines

Implications for vendors

Project 6-96-2

VFI

Implications for vendors

Purpose of this presentation

- To explain why the project was undertaken
- To describe how it was undertaken and its conclusions
- To explain the VFI system
- To explain how this will affect vendors

VFI

Implications for vendors

Definition of VFI

Vendor Furnished Information (VFI) is the information provided to the shipyard by the vendor to support the design of the ship and the procurement, installation and operation of the equipment.

VFI

Implications for vendors

U.S. / International commercial shipbuilding comparison

Design and build cycle time

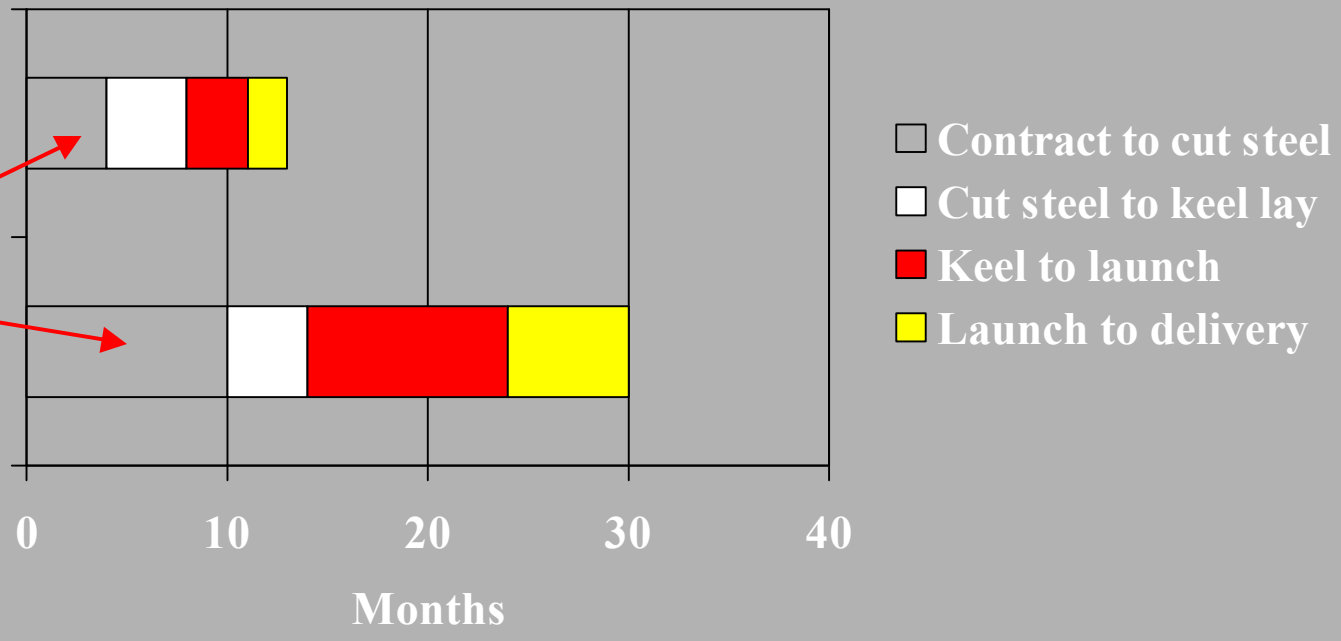
Material and equipment cost

VFI

Implications for vendors

Design cycle times

Typical Suezmax Tanker Schedule USA & Europe

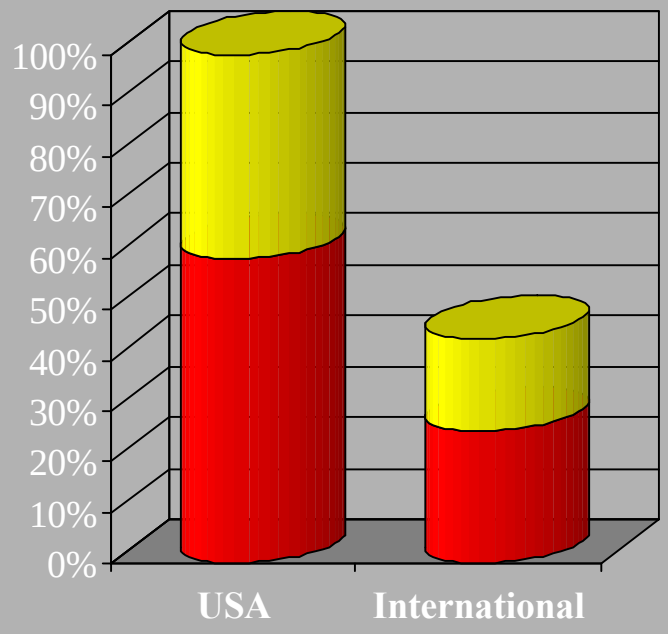


Design can take about 2.5 times longer in the U.S.

VFI

Implications for vendors

Ship cost



Observations:

- Overall breakdown similar
- U.S. material and equipment cost higher
- U.S. pre-production and production costs higher

VFI

Implications for vendors → **Action**

In order to assist in becoming internationally competitive, U.S. shipbuilders are taking steps to reduce design cycle times and the cost of materials and equipment

The VFI project will help to achieve this

VFI

Implications for vendors

Project objectives

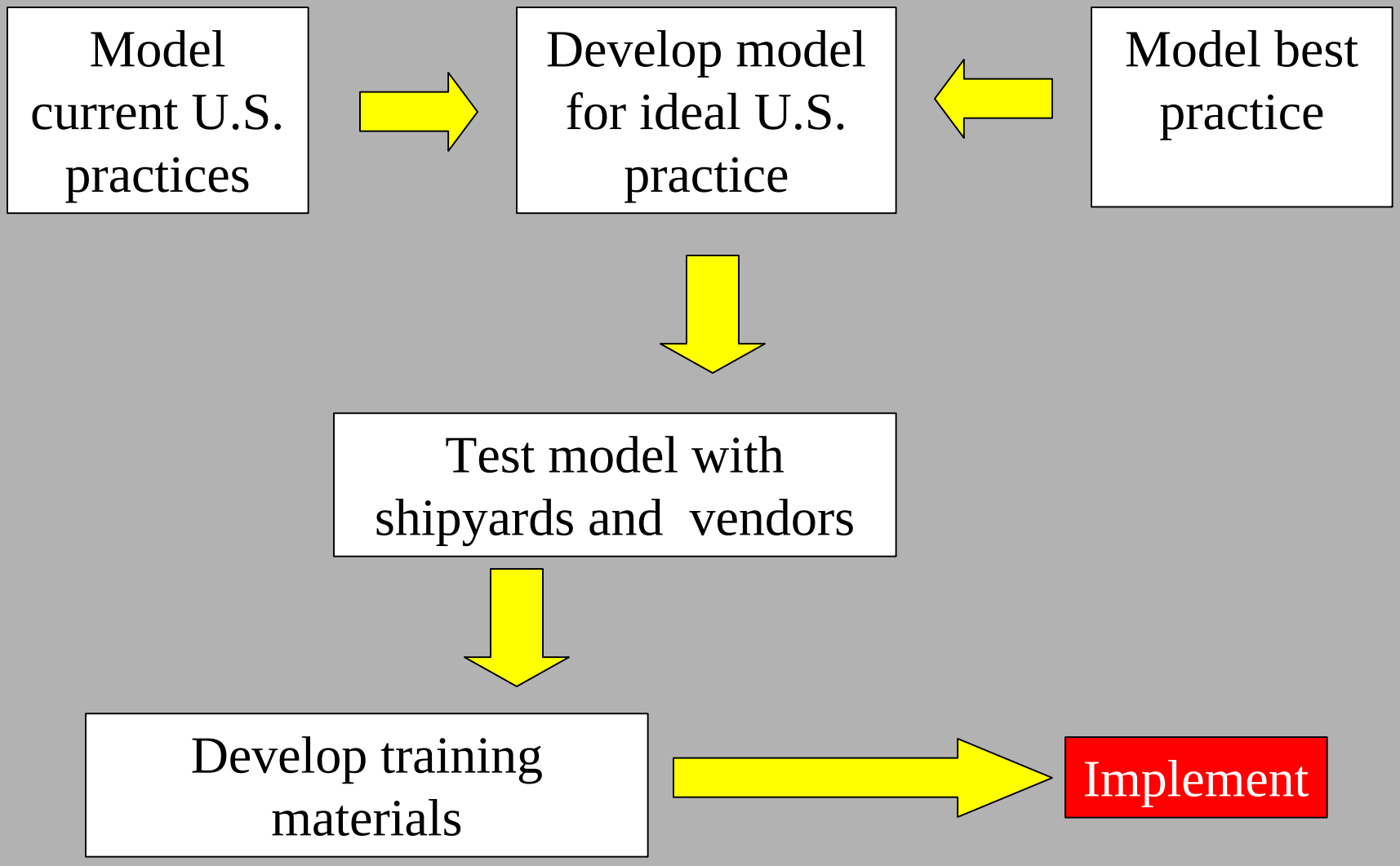
To assist in improving the international competitiveness of U.S. shipyards by ……...

- identifying how the U.S. design process can be modified to ease the problems for shipyards and vendors relating to VFI
- producing a system to specify and co-ordinate the supply of Vendor Furnished Information

VFI

Implications for vendors

Approach



VFI

Implications for vendors

Input and involvement

Project contributors included……

- U.S. shipbuilders
- U.S. design agencies
- U.S. vendors
- European shipbuilders
- European vendors
- European shipbuilding consultants

VFI

Implications for vendors

Design / procurement model

Key Features……..

Partnerships with preferred vendors

3D CAD models with database of attributes

Detailed standards for:

materials and equipment

structural components

layouts etc

VFI

Implications for vendors

VFI system

Key Features……..

Provides structure to information requirements

Aligns the supply of information to the design process

Reduces: lead time

shipyard administration costs

supplier costs (and prices)

human error

Improves shipyard competitiveness

VFI

Implications for vendors

Types of VFI

Documents and data relating to……..

- Contract / Administration
- Mechanical aspects
- Electrical aspects
- Certification
- Installation
- Quality assurance and control
- Weight control
- Instrumentation
- Spare parts
- Operations and maintenance

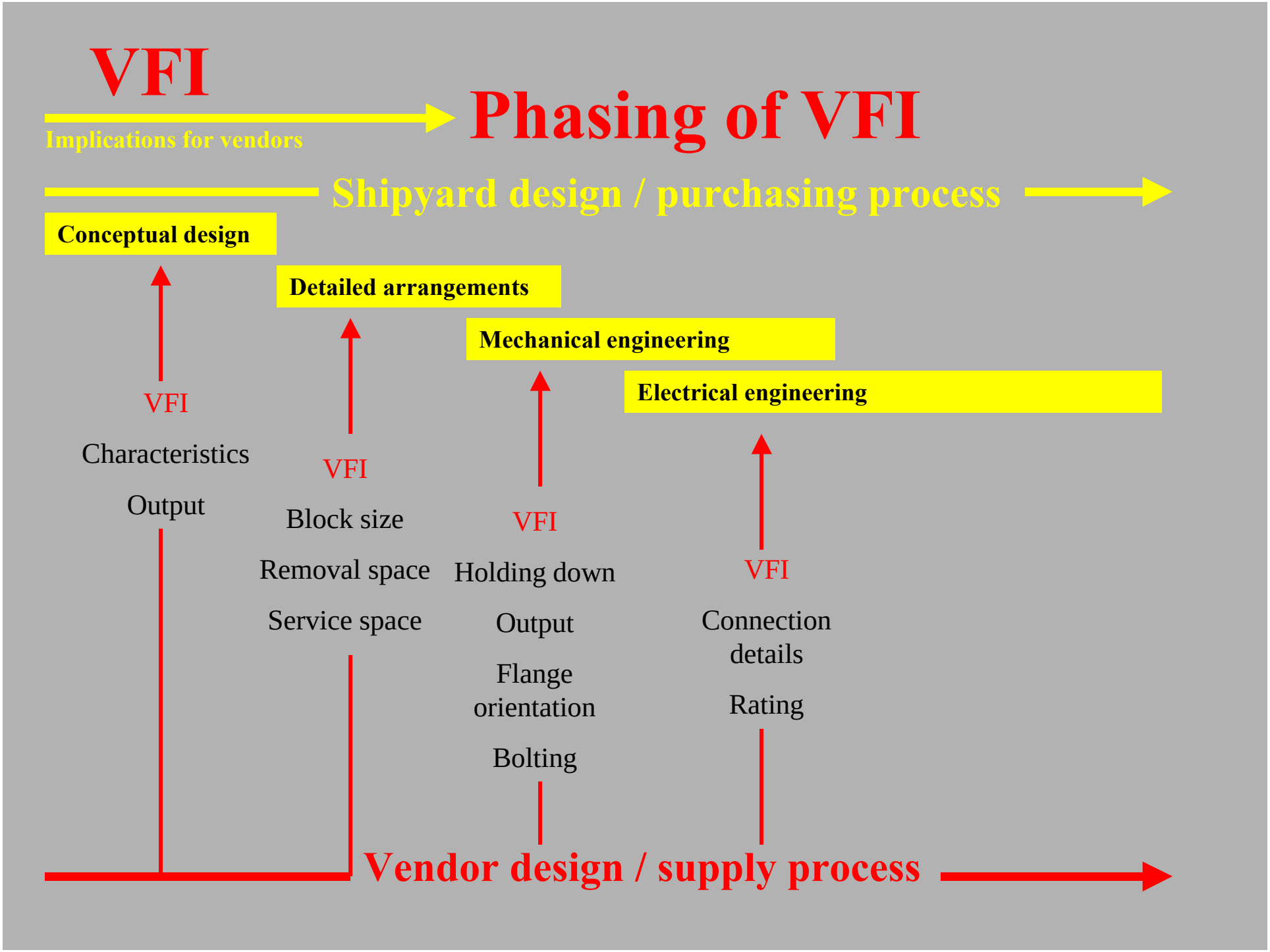
VFI

Implications for vendors

Types of VFI

86 items of VFI have been identified

Only a selection of them apply to each piece of equipment


VFI
Implications for vendors
Phasing of VFI
Shipyard design / purchasing process
Conceptual design
Detailed arrangements
Mechanical engineering
Electrical engineering
VFI
Characteristics
Output
VFI
Block size
Removal space
Service space
VFI
Holding down
Output
Flange orientation
Bolting
VFI
Connection details
Rating
Vendor design / supply process

VFI

Implications for vendors

Key dates

Information is related to the following key dates……..

- Submission of the bid to supply equipment
- Purchase order issue date
- Factory acceptance trials
- Dispatch from vendor
- Receipt in the shipyard

There could be others

VFI

Implications for vendors

VFI matrix

The 86 items of VFI are presented in a matrix

Grouped by information type

Specifying the required date

Example for VFI relating to QA and QC shown on the next slide

VFI

Implications for vendors

VFI QA & QC matrix

1 Quality Assurance and Quality Control

VIRL NUMBER and DESCRIPTION		REQUIRED DAYS				
		With Bid	Draft for review	Final Docs reqd	Delivery with equip	Archived by Vendor
Q01	CORPORATE QUALITY MANUAL Vendor's manual detailing quality policies, procedures and organisation. Quality System Approval Certificate by Accredited Body.	Yes				
Q02	PROJECT QUALITY PLAN Vendor's QA plan detailing organisation and procedures specific to this project.		Yes	4 wks after PO		
Q03	QUALITY INSPECTION AND TESTS Inspection plan indicating specific quality activities – tested by, witness by, etc.		Yes	4 wks after PO		
Q04	PROJECT PLAN A plan is to be submitted for approval showing how and when events are to be achieved from award to shipment. Key dates including documentation issues as required by this VIRL to be shown.		Yes	4 wks after PO		
Q05	PROGRESS REPORTING Monthly progress reports against the project plan are to be provided.		Yes	At PO		
Q06	BUYER'S INSPECTION Items/equipment will be subject to on-site inspection prior to despatch.				Prior to despatch	

* Note:- Archived by Vendor means that it shall be the responsibility of the Vendor to retain this information for the duration of the Guarantee Period.

VFI

Implications for vendors

Status of the information

The matrix also indicates ……...

- if a draft for review is required
- when the final documents are required
- if the information should be archived by the vendor

Further simplified if standards are used

VFI

Implications for vendors

Data sheets

It is intended to standardize how the data is handled

Applies to both procedures and the format of data

Example data sheets for…….

Weight control	Motors	Lubricating oil
Noise	Spares	Tools
Commissioning spares		Insurance spares

…….. have been included in the text

An example of a tool list is on the following slide

VFI

Implications for vendors

Tool list data sheet

TOOLS LIST

ANNEX F

SHIP NUMBER:-	
SUPPLIER NAME:-	
ORDER NUMBER:-	
MATERIAL NUMBER:-	
EQUIPMENT NAME:-	
TAG NUMBER:-	

Working No. Per Set	
Depot No. Per Set	
Description	
Re-Ordering No.	
Price	
Remarks	
Upplier's Spares Department Address: Telephone: Fax:	

VERIFIED		DATE	

ONE SHEET TO BE COMPLETED FOR EACH INDIVIDUAL BUYER MATERIAL NUMBER WITHIN THE SCOPE OF SUPPLY

VFI

Implications for vendors

Implementation

Shipyards are planning to rationalize their relationship with vendors in three phases…….

Short term - rationalize VFI in existing organization

Medium term - update design processes and adopt standards

Longer term - move towards full vendor partnerships

Looking at short term implementation…….

VFI

Implications for vendors

Implementation steps

Shipyard project team and steering committee set up

Study VFI project documents

Discuss VFI proposed developments with key vendors

Finalize implementation plans

Educate all relevant shipyard personnel

Educate all vendors

Implementation organization

A dedicated shipyard project team of three people has been set up to implement the changes

The effects of the changes are far reaching so a steering committee consisting of representatives from the following departments has also been set up:

- Estimating
- Preliminary design
- Engineering (all areas)
- Purchasing
- Quality assurance
- Production
- Tests and trials
- After-sales support

VFI

Implications for vendors

Effect of the changes

Key points (short term)……..

Form and content of VFI - *the form and content of VFI requested by the shipyard will change to align it with the design process. There will be less detail required with the tender and the supply of information will be phased.*

Standardization of VFI - *in order to avoid duplication and ensure that nothing is missed, standard forms and formats will be used for the supply of VFI.*

Information with the tender - *a full list of VFI required with delivery dates will be issued at the tender stage.*

Point of contact - *a single point of contact in the shipyard will be specified.*

Delivery point - *the delivery point for each piece of VFI will be specified.*

VFI

Implications for vendors

Future developments

Delivery medium - *over time, the delivery medium will move from away from paper to electronic formats.*

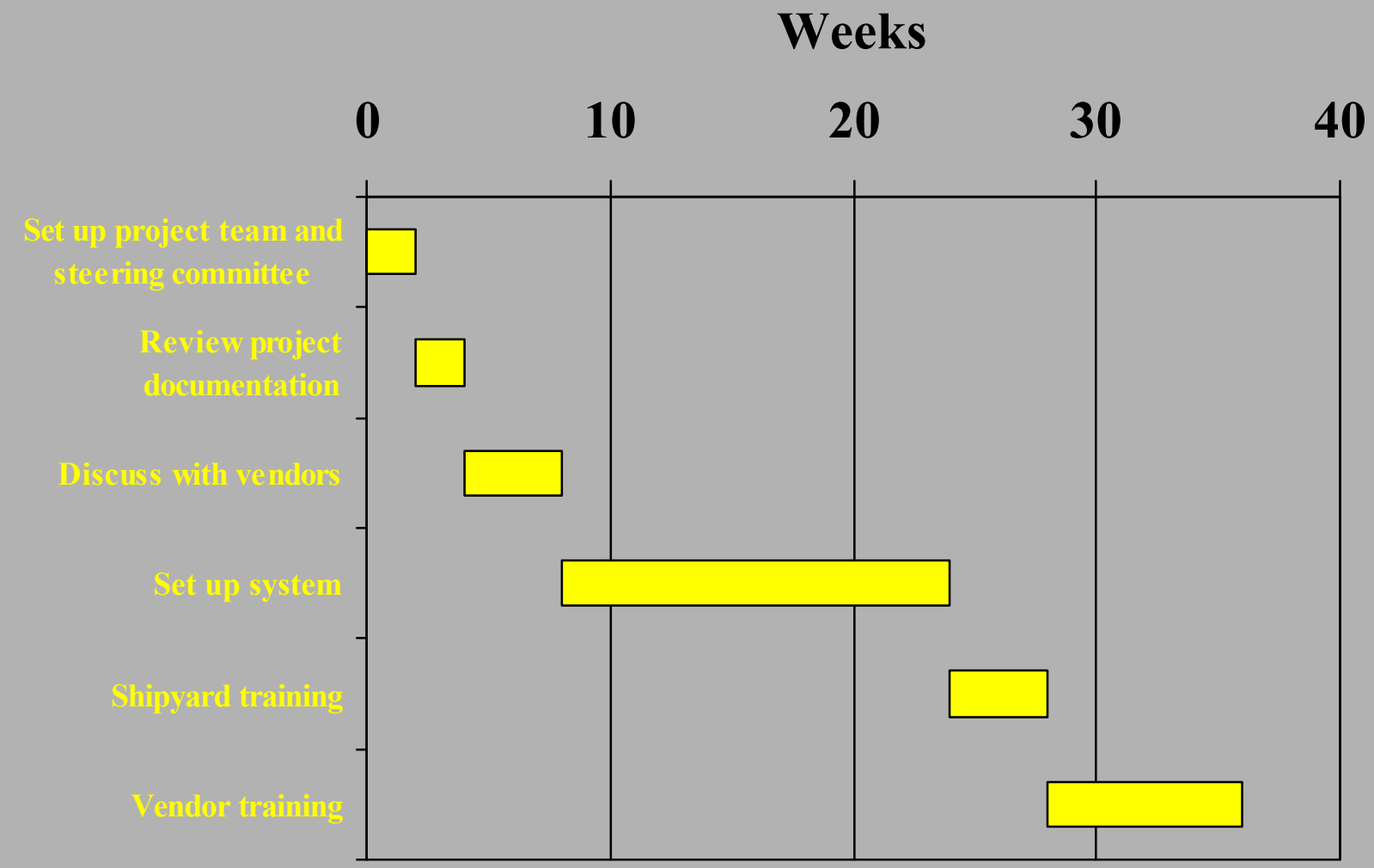
Relationships - *Shipyards wish to develop vendor partnerships and the relationship will extend beyond the current purchase order.*

Standards - *shipyard specific equipment standards will be adopted which will be used as a basis for all designs produced by the yard.*

VFI

Implications for vendors

Implementation time-scale



THE END

APPENDIX H

Vendor Furnished Information (VFI) Interactive Model

The main report will produce a list of Vendor Furnished Information associated with the material or equipment selected from the VFI list. (Interactive presentation).

This is a Microsoft Access database to be downloaded separately.